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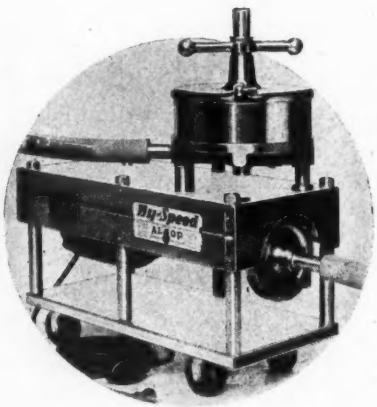


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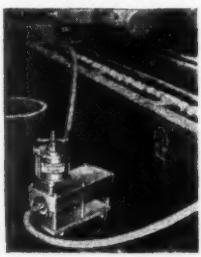

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# Metal Finishing, Where Next?

By E. T. CANDEE

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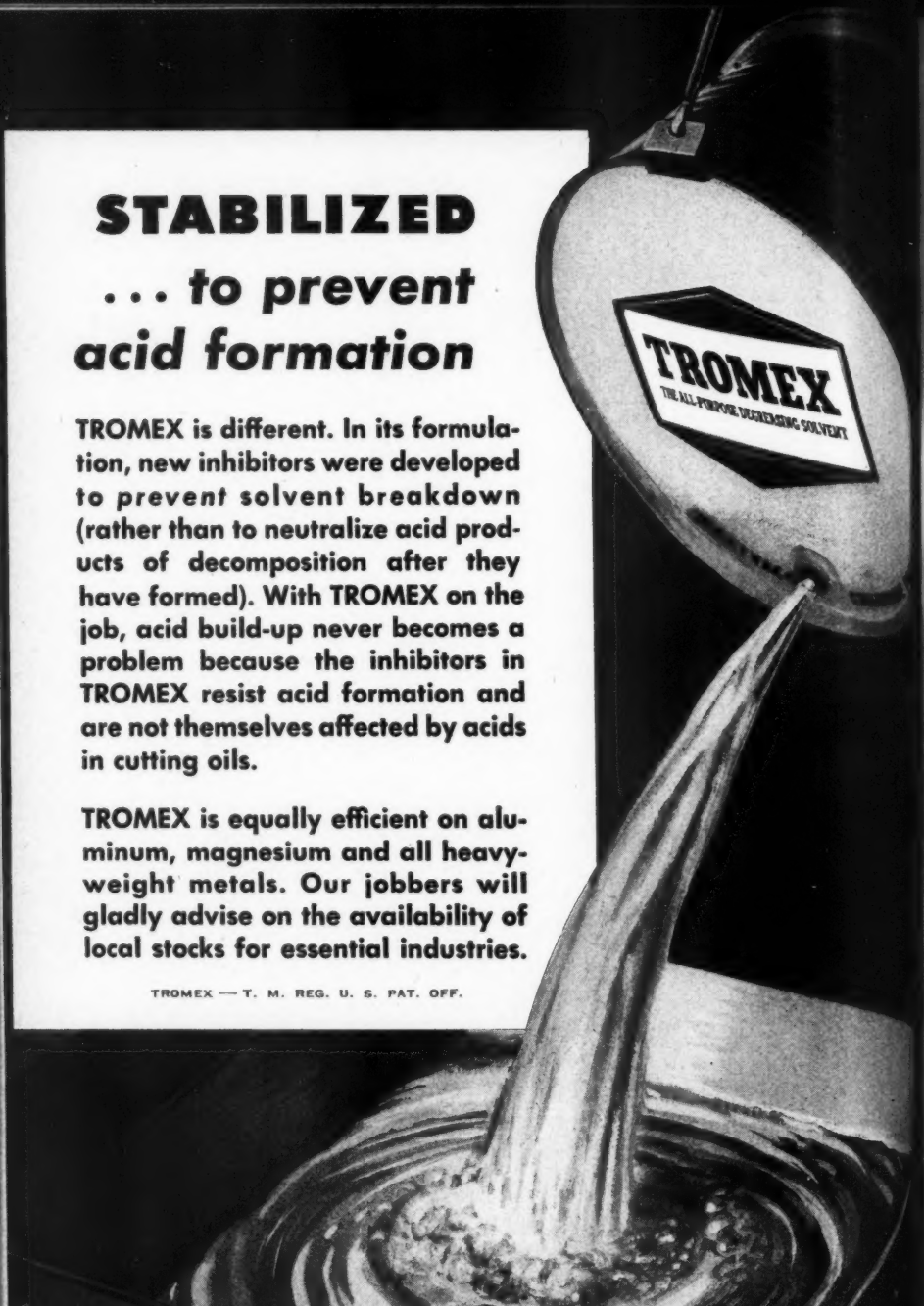


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# The Fundamentals of Electrochemistry and Electrodeposition

Part XVII. Electrolysis of Complex Cyanide Solutions

**By SAMUEL GLASSTONE, D.Sc., Ph.D.**

*Professor of Chemistry,*
*The University of Oklahoma, Norman, Okla.*

IN Part II (*Monthly Review*, September, 1941) some reefrence was made to the formation and structure of complex ions. However, in view of the great practical importance of these ions, it will be worth while to describe their properties in further detail, with special reference to the problems of electroplating. The treatment here will be concerned more specifically with complex cyanides, since these outweigh other complex ions in the extent of their usefulness. It is well known, for example, that it is not possible to plate silver satisfactorily from a solution of one of its simple salts, such as the nitrate, but good deposits can be obtained from complex cyanide solutions. The cyanide bath is, in fact, almost invariably employed for silver and gold plating; although other baths have been proposed from time to time, the cyanide solution is still of prime importance. Cyanides are also frequently employed for the deposition of zinc, copper and cadmium, and especially for the production of alloys, such as brass, by electrolytic methods.

## FINE-GRAINED DEPOSITS FROM CYANIDE BATHS

The exceptional properties possessed by complex cyanide solutions in yielding smooth, fine-grained deposits of silver and other metals appears to be related in some manner to the fact that very few simple ions of the metal are present in these solutions. For example, when silver cyanide is dissolved in either potassium or sodium cyanide, the complex argento-

cyanide ion, $Ag(CN)_2--$, is formed; thus, with potassium cyanide the reaction may be represented by

$$AgCN + KCN = K+ + Ag(CN)_2--.$$

The complex ion dissociates to a very small extent to form simple silver ions, $Ag^+$, but the concentration of these ions is extremely small. It is possible that when the solution is electrolyzed the latter, in spite of their small amount, are discharged at the cathode and are thus deposited as metallic silver. However, if this is the mechanism of the process there does not seem to be any special reason why a smooth plate should be formed, particularly as electrolysis of silver nitrate solution, which contains only simple ions, gives a coarse deposit.

## METAL DEPOSITION AS A SECONDARY PROCESS

The view has therefore been generally accepted that silver is deposited from complex cyanide solutions as the result of an indirect, or secondary, process occurring at the cathode. One suggested mechanism is that the potassium (or sodium) ions are first discharged to form the potassium metal, and that this then reacts with the argentocyanide ion to yield silver, thus

$$K+Ag(CN)_2-=K++2CN-+ Ag\ (metal).$$

Since the silver is not produced by direct discharge, but as the result of a secondary reaction, it might well be in a finely-divided state. The objection to this proposal is that it is unlikely that potassium would be discharged from a solution at the potential at which silver is actually obtained. Further, the discharged potassium atom is supposed to react immediately with the argentocyanide ion to regenerate a potassium ion, as the equation given above shows; such a reaction would mean that the potassium ion is very reluctant to be discharged.

Another mechanism, to which less objection can be taken, is that the $Ag(CN)_2^-$ ion takes up an electron at the cathode to form the unstable ion $Ag(CN)_2--$ with a double negative charge. This ion would decompose immediately to form metallic silver according to the equation

$$Ag(CN)_2--=Ag\ (metal) + 2CN-.$$

Here again, the silver is obtained as a secondary product and need not be in the coarse form that results when simple silver ions are discharged.

The present writer has made a third suggestion which has received

the support of a number of electrochemists. It is based on the little known fact that complex cyanide solutions contain small amounts of positive complex ions, in addition to the familiar negative complexes. There are reasons for the belief that there is present in a silver cyanide solution a small concentration of $Ag_2CN^+$ ions; these would be discharged at the cathode to form the unstable unit $Ag_2CN$ and this would split up instantaneously, thus

$$Ag_2CN = Ag \text{ (metal)} + AgCN,$$

to yield silver metal and silver cyanide. The latter would mostly dissolve in the cyanide solution, but the presence of traces of silver cyanide, formed at the same time as the silver, would be just the factor to account for the fine-grained deposit. This aspect of the subject will be brought out in the next article.

## DEPOSITION POTENTIALS FROM CYANIDE SOLUTIONS

A fundamental point to remember in connection with cyanide solutions is that as a result of the large decrease in the concentration of simple ions, the deposition potentials of the metals are considerably altered. This may be seen from the following table giving the potentials for the deposition of silver, copper, cadmium and zinc from solutions of their simple salts and from complex cyanide solutions. (Reference to the column headed "Hydrogen Evolution" will be made later). These

**Deposition Potentials**

| Metal | Simple Salt Solution | Complex Cyanide Solution | Hydrogen Evolution |
|---|---|---|---|
| Silver | +0.80 volt | −0.5 volt | −0.80 volt |
| Copper | +0.34 | −1.0 | −0.85 |
| Cadmium | −0.40 | −0.9 | −1.10 |
| Zinc | −0.76 | −1.2 | −1.3 |

figures are not exact, because they vary somewhat with the composition of the solution, but they are of the right order for solutions containing excess of free cyanide, such as are used in practice, and may be adopted for purposes of discussion.

## DEPOSITION POTENTIALS FROM CYANIDE SOLUTIONS

It is at once obvious that the potentials in the cyanide solutions are very different from those in the simple salt solutions. One effect of these changes is to bring together the potentials at which zinc and copper deposit. From solutions of their simple salts, such as the sulfates, copper deposits at +0.34 volt and zinc at −0.76 volt, and hence if a mixture of the two sulfates is electrolyzed copper will plate out first in a pure state; zinc will deposit only if the current density is very high or if the copper is almost exhausted from the solution (see Part XIV, December, 1942). The deposition potentials of the metals from a solution containing the complex cyanides of copper and zinc are, however, so close together that they plate out simultaneously in the form of an alloy. It is possible in this manner to obtain brass deposits containing varying amounts of copper and zinc, and hence with a variety of colors, by changing the proportion of the cyanides in the electrolytic bath.

An examination of the deposition potentials in the table given above shows that cadmium deposits from a complex cyanide solution at a potential close to that of both zinc and copper. It is thus possible to plate out alloys of zinc and cadmium, and of copper and cadmium with various compositions. The so-called "copper-cadmium bronze" is produced by the electrolysis of solutions containing complex cyanides of two metals. Ternary alloys containing all three metals, copper, cadmium and zinc, can also be deposited if desired.

## HYDROGEN EVOLUTION FROM CYANIDE SOLUTIONS

There is still another factor connected with cyanide solutions that must be considered; this is the question of hydrogen evolution. Since the deposition potential of a metal from a complex cyanide solution is more negative than from a simple salt solution, the possibility of hydrogen being liberated is increased. This is compensated, to some extent, by the fact that all cyanide solutions are fairly alkaline, and so the hydrogen evolution potential is more negative than from a neutral or acid solution. Even without the alkali that is sometimes added to cyanide baths, the pH of most complex cyanide solutions containing some excess free cyanide would be about 11. According to equation (2) of Part XV (January, 1943) the potential for the reversible liberation of hydrogen from such a solution will be −0.65 volt, and if the overvoltages of the respective metals are added to this, the hydrogen evolution potentials recorded in

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the last column of the table are obtained. Comparison of these figures with those in the preceding column for metal deposition from the same solution reveals some interesting points. It is seen that for silver, cadmium and zinc the metals are deposited at potentials that are somewhat less negative than those for hydrogen evolution. In other words, the metal should be liberated from these solutions in preference to hydrogen; this is true for silver and cadmium up to quite high current densities, although with zinc there is some tendency for simultaneous hydrogen evolution. It is thus found that silver, cadmium and zinc can be deposited from complex cyanide solutions with high current efficiencies, viz., 85 to 100 per cent. With copper, on the other hand, the table shows that hydrogen evolution should occur, theoretically, in preference to copper deposition. Actually, at all reasonable current densities, both copper and hydrogen are plated out at the same time; this accounts for the fact that the cathode efficiency for copper deposition from cyanide solutions is generally as low as 40 to 60 per cent. The behavior of complex cyanide solutions can thus be readily understood by applying some of the simple, fundamental principles of electro-chemistry.

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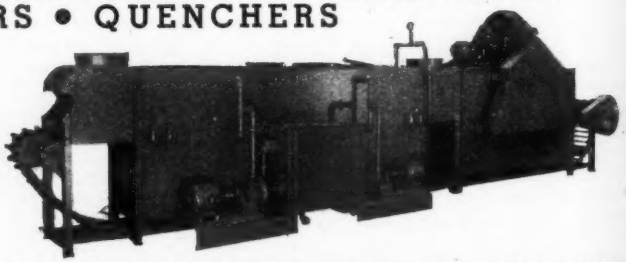

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# Recent Developments in Zinc Plating

By MYRON B. DIGGIN**

*Chief Chemist*
*Hanson-Van Winkle-Munning Company*

IN presenting this paper to the Chicago Branch of the A.E.S. on "Recent Developments in Zinc Plating," emphasis will be placed on practice rather than theory regarding the solutions and treatments to be discussed. I shall not attempt to cover the whole field of zinc plating but rather tell you about some important developments and observations which are relatively new or which have assumed immediate importance.

Ten years ago there was not a great deal of choice for a manufacturer who wished to protect ferrous articles against corrosion with zinc. He could choose hot galvanizing for many bulky articles where the thickness of the coating would not interfere with operational use. For many purposes, however, galvanizing was either too expensive, it lacked eye appeal, or, from an engineering standpoint, it could not meet dimensional tolerances.

When the manufacturer turned to electrodeposited coatings, the choice lay between *acid zinc* and *cyanide zinc deposits*. Acid zinc solutions produced frosty white deposits which often had relatively low protective value. The throwing power of acid solutions was amazingly poor. Furthermore, the pH of acid solutions as unstable, despite attempts to employ buffers. The unalloyed zinc anodes used were chemically attacked, resulting in large metal losses. About the only favorable characteristics of acid baths, outside of large scale strip or wire plating, were that the solution was inexpensive, and that it was a less complex solution to control.

Turning to cyanide zinc solutions as they were used ten years ago, there was little choice offered. Deposits from the 8-3-7* or 8-5-7 solutions ranged from dull-grey to dull-white. As the effects of impurities and methods for the removal of these impurities were not fully known, the

*Zinc cyanide, sodium cyanide and sodium hydroxide, in ounces per gallon.

**Presented at Thirty-first Annual Educational Session, Chicago Branch.

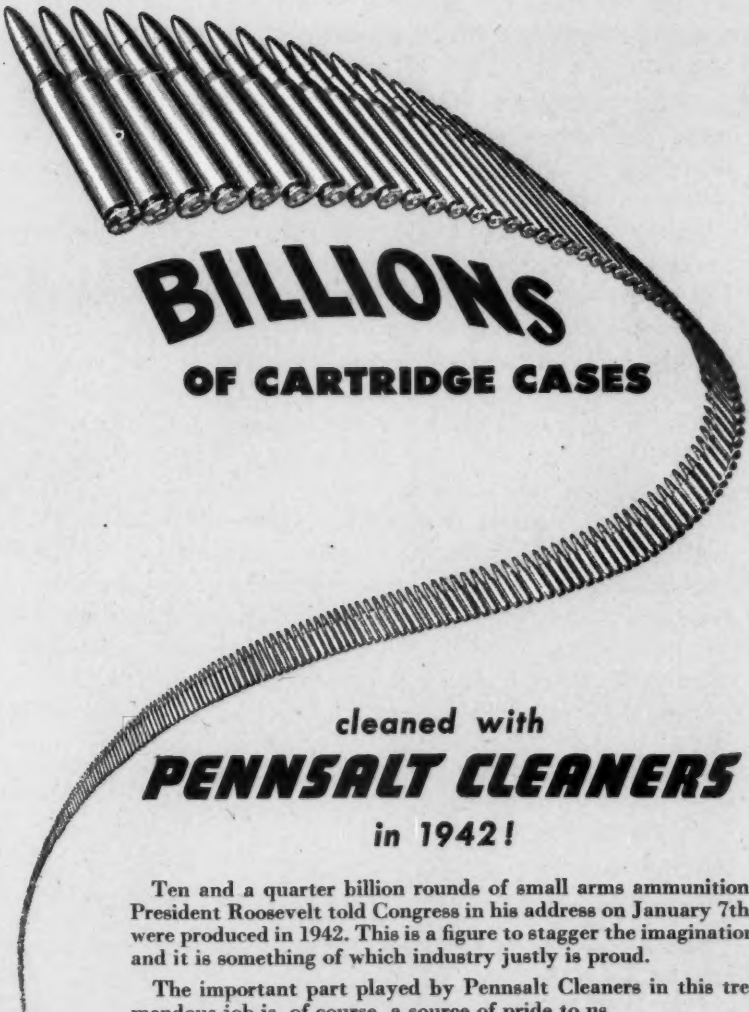
results were often disappointing in comparison with bright cadmium coatings, the use of which was at that time expanding rapidly. In comparison with cyanide zinc solutions, bright cadmium solutions produced coatings which were pleasingly lustrous and which had less tendency to stain or tarnish; as a result articles coated with cadmium were more salable. Furthermore, cadmium solutions were much less difficult to operate and control. Despite its relatively high cost, cadmium gradually supplanted zinc in thousands of applications.

It is interesting to observe that bright zinc processes were introduced several years ago at about the time that the price of cadmium skyrocketed because of an unbalanced supply in the face of increasing demands for cadmium, not only for use in plating but for use in automobile bearings. In view of the excellent results that could be obtained with bright zinc processes, if handled properly, it was my prediction in an article published at that time that the use of zinc plating would expand and that cadmium would never again enjoy a virtual monopoly as a finish on consumer's goods at all, and many other articles where corrosion resistance was of prime importance. Since then, the tests made by the joint committee of the A.S.T.M. and A.E.S. have demonstrated that zinc coatings have almost identical protective value as compared with cadmium coatings of equal thickness in all but salt spray tests which, incidentally, do not represent actual exposure conditions, even in a marine atmosphere.

Bright zinc solutions have several advantages over ordinary dull-plating solutions aside from the lustre of deposits. Some of the bright solutions are capable of being operated at current densities of 60 amps./sq. ft. without agitation. This more than compensates for the increased time required to deposit a definite thickness of zinc in comparison with cadmium. By selecting a lower current density-well within the bright range, for example: 45 amps./sq. ft. irregularly shaped and protruding articles can be plated without danger of "burning" the exposed portions. In ordinary unagitated zinc solutions the maximum cathode current density is around 25 amps./sq. ft., with a risk of "burning" exposed areas if this limit is exceeded.

Because of their sensitivity to impurities, the operation of bright zinc solutions has taught us a great deal about solution cleanliness, the use of high purity alloy anodes, the importance of proper anode current density, and chemical control.

Bright zinc deposits have much less tendency to stain during rinsing and drying operations and when exposed in an unfavorable environment.



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This is especially true of forgings or castings that have been sandblasted before entering the plating cycle.

While ordinary zinc solutions have a poorer throwing power than bright cadmium solutions, bright zinc solutions approach cadmium baths in this respect. This characteristic is probably connected with an observable increase in cathode polarization.

Another advantage of bright zinc baths over ordinary zinc solutions lies in their ability to cover the surface being plated more completely. This is especially true as applied to castings. This special application will be discussed later.

Under wartime conditions, it is not necessary to produce goods with bright attractive finishes as our customers today are primarily interested in how the articles will function on the battlefronts. Bright zinc solutions would therefore appear to be unessential. In view of the advantages given above, combined with ease of inspection, It is interesting to note that all of the conversions from cadmium to zinc that we have made within the past six months have involved bright zinc or semi-bright zinc processes.

A semi-bright zinc solution has been deeloped which has a wide current density range and excellent throwing power. It is therefore applicable to the plating of a wide variety of war goods. Many conversions from cadmium to zinc have been made and several full automatic conveyors will be operating shortly using a semi-bright solution. The formula for this bath is:

| | | |
|---|---|---|
| Zinc cyanide | 8 | oz./gal. |
| Sodium cyanide | 5 | " |
| Sodium hydroxide | 12 | " |
| Zinc addition agent S-B | 0.8 | " |

The zinc addition agent is composed of a balanced mixture of sodium fluoride, gum Arabic, cystine and other amino acid derivatives. Sodium fluoride and gum Arabic additions are mentioned in several textbooks. These two materials can be used without amino acid derivatives, with some loss in lustre. Although the mixed addition agent has a brightening effect upon the dospit, we prefer to term it "addition agent" rather than a "brightener." The effective life of the addition agent in the solution, unlike many brighteners, is from one to three months, depending upon the degree of drag-out.

In unagitated solutions the cathode current density range is 10-40 amps./sq. ft. Maximum brightness is obtained if the solution temperature

# Clean, even deposit

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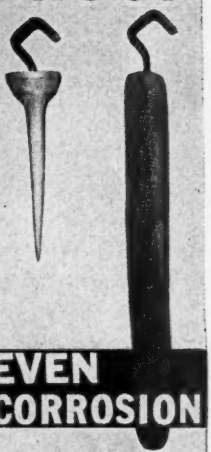

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is maintained at 70-75° F. Within this temperature range, the cathode current efficiency at 30 amps./sq. ft. is 86%. The deposits are somewhat lustrous as they are taken from the plating bath. A momentary dip in a ½% nitric acid solution increases the brightness and gives the deposit a lighter tone.

If the semi-bright solution is operated at around 100° F, the cathode efficiency is increased to 95% but the deposits lose a slight degree of brightness. When bright dipped, the plated surface acquires a pleasing satin-like lustre.

The semi-bright solution should be prepared and operated with the care usually taken with bright solutions in respect to heavy metal contaminants. A treatment with Standard Zinc Dust No. 122 or No. 22 in the proportion of one pound per 100 gallons is advisable when preparing a new bath. Should contamination occur later, as indicated by bright-dipped work turning black or brown, the zinc dust treatment will quickly restore the solution to its original condition.

Semi-bright deposits can be successfully Bonderized, Cronaked, blackened or heat-relieved. The deposits produced are unalloyed electrolytic zinc having excellent protective value. Zinc-aluminum alloy anodes are recommended. The use of mercury-containing anodes is not permitted in solutions producing work for many ordnance purposes.

In view of the many conversions of plating solutions that are being made from cadimum to zinc, I should like to digress for a moment to discuss the technique of converting. In plants where cadmium deposits have been coming from the solution bright, and where light-colored, bright and semi-bright coatings must be maintained during conversion, my advice is: "do not convert" but rather set aside the cadmium solution, thoroughly clean the plating tank or barrel apparatus, and then prepare an entirely new zinc solution.

If this procedure is not permitted, or if off-colored deposits will be accepted temporarily, the conversion can be accomplished by operating the solution with empty ball anode containers or steel anodes until the metal concentration decreased to 1.25 oz./gal., or even lower if the quality of deposits can be maintained. At this point add 3.0 oz./gal. of zinc oxide and 4.0 oz./gal. of sodium hydroxide. The use of oxides containing lead or copper should be avoided.

After the salts have dissolved, hang cleaned work or dummy steel sheets in the solution from the cathode rod, and then suspend zinc anodes

from the anode rod with the current connected. By doing this, the cementation of cadmium sponge on the zinc anodes will be minimized. Until all of the cadmium is plated from the solution, it is advisable to apply current continuously. If it is not feasible to do this; for example, if the plant is not operating overnight, the anodes should be removed during the idle period.

When the bath has been operated for 8—12 hours at full capacity, test a portion of the solution with sodium sulphide and note the color of the precipitate. If the yellow color of cadmium sulphide is not evident, analyze the bath as a zinc solution and then add a sufficient quantity of zinc oxide, caustic soda, sodium cyanide and brightening agent to secure a bath of what ever composition is selected.

In converting to a semi-bright or bright process, a zinc dust treatment is advisable as heavy metal impurities, particularly copper, are usually present in harmful quantities. Treating with zinc dust before all cadmium has been plated out is only partially effective because of the cementation of cadmium on the zinc dust particles as described above.

The electroplating of malleable and grey iron castings with zinc has long been considered to be difficult and uncertain in results. Because of the low hydrogen overvoltage in an alkaline solution, there is a tendency for hydrogen gas to be discharged at the cathode in preference to zinc metal. We have had many castings sent to our laboratory for experimental zinc plating. Some of the castings can be completely covered with zinc without special attention; that is, by following the same procedure used in plating cold or hot rolled steel articles. Other castings with a similar physical appearance are only partially plated or refuse to accept any zinc whatsoever when processed in an identical manner. In some cases, these castings can be plated if the cleaning and pickling cycles are modified or if special plating baths and procedures are employed.

For several months we have been investigating this subject, first of all in an attempt to establish the reason why some castings plate and others do not. The physical appearance of castings as they come to the plating department apparently has little bearing upon their ability to accept zinc, presuming, of course, that they have been thoroughly cleaned by sand or shotblasting to remove oxides, sand and slag. Obviously a skin of foreign material will not only change the electrochemical characteristics but will lead to a poorly protective deposit. Sand and oxides can be removed by hydrofluoric, hydrochloric or sulphuric acid pickles, but pickling is a definitely unsatisfactory substitute for mechanical abra-

sive cleaning; in fact, prolonged pickling may, and usually does, produce undesirable surface characteristics.

Machined or ground castings can usually be zinc plated satisfactorily although we have noted exceptions, especially on threaded parts. The chances of obtaining good coverage in the case of machined articles are definitely better than on the sandblasted or shotblasted surfaces usually encountered.

Many modifications of plating procedures have been proposed in the past for overcoming the difficulties in zinc plating castings. In most cases, the use of a cadmium "flash" will change the electrode potential so that when the article is transferred to a zinc bath, plating will proceed in a normal manner.

This procedure is satisfactory where the use of cadmium is permitted, and where the metal is cleaned sufficiently to receive a continuous cadmium coating. There is a disadvantage in using this procedure, in that extra equipment and extra operations are required.

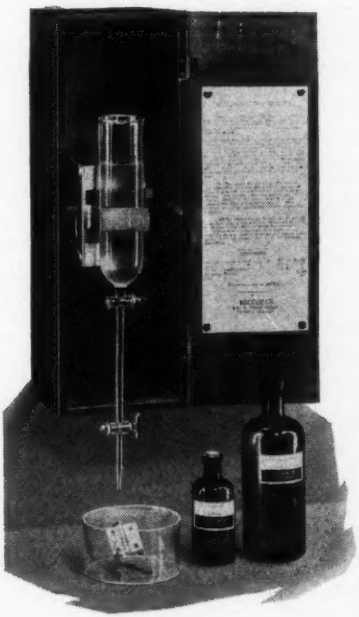
Another modification of plating procedure which is a favorite "trick" of many platers is to toss a small quantity of cadmium oxides or other cadmium salts into an alkaline zinc solution. The cadmium salt dissolves as a complex cadmium sodium cyanide and is plated out preferentially on the cathode, changing its potential toward the solution. Once a film of cadmium is deposited, zinc plating proceeds in a normal manner. This scheme is workable but has certain drawbacks. In the first place, the operator can never be certain that there is enough cadmium present at any given time to obtain the desired results. Its use must be watched carefully to obtain consistent results and to utilize the cadmium salts economically.

The second objection is that cadmium is replaced electrochemically by zinc in the bath. This results in the formation of cadmium sponge on the anodes. This reaction not only leads to cadmium metal loss but after a time has an objectionable effect at the cathode. From the standpoint of solution control, the cadmium sponge formed is the same as any dirt or suspended matter in the bath, and as such, will lead to rough deposits. This is particularly true in bright zinc plating.

The use of mercury salts in zinc solutions has been proposed to make possible the plating of iron castings. It is claimed that the addition of mercuric oxide to the bath in proportions up to 2% of the zinc content not only gives good coverage of zinc, but also increases the cathode efficiency and produces a whiter deposit. The improvements claimed cannot

# ZINC

## SOLUTIONS AND DEPOSITS



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always be realized. Aside from this, we are of the opinion that at present the use of mercury in any form is discouraged. Furthermore, certain industries will not permit the use of mercury or mercury salts because of the possibility of amalgamation and also the season cracking of brass parts in assemblies. In addition to these objections, the process may not be economical under some conditions of operation because of large mercury losses.

Another method of securing satisfactory coverage is to first acid zinc flash the castings and then, after rinsing thoroughly, transferring the castings to an alkaline zinc bath. It would seem logical to conduct the entire zinc plating operation in acid solutions, but; in the first place, it is claimed that acid zinc deposits of lighter thicknesses are not as protective as those produced in alkaline solutions as referred to in the Bureau of Standard Research Paper No. 867; and secondly; the throwing power of acid zinc baths is astoundingly poor. It is this latter characteristic that makes the use of an acid zinc flash useless on all articles except those of relatively simple shapes. Again there is the disadvantage of multiple plating operations.

Many conditioning dips have been proposed for treating castings to be alkaline zinc plated, the most recent consisting of a thirty-minute dip in a hot (nearly boiling) concentrated sodium cyanide solution. This has been tried on admittedly difficult-to-plate castings without success. A prolonged dip in a cyanide solution is objectionable as salts are retained in the pores in the metal which cause "spotting out" later, especially when the parts are used or stored under conditions of high humidity.

We have experimented in our laboratory with an alkaline tin flash in a solution of high alkalinity and low metal concentration. Such a solution has a low cathode efficiency when used as high current densities but has remarkable throwing and covering power. By using this strike excellent results were obtained. There is some question as to the electrochemical effect of the tin undercoating in respect to the corrosion protective qualities. This investigation was not completed because of the present strategic position of tin.

Malleable and grey iron castings should not be overcleaned or overpickled. If the castings have been machined and as a consequence are covered with oil, they should be degreased. To remove sand and slag, sandblasting is preferred, although shotblasting is effective. The articles should be electro-cleaned in an alkaline solution. Ordinarily the work is made cathodic, but where racks are used and they are returned through

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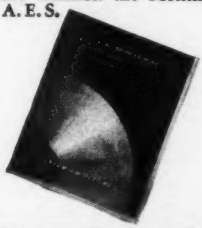

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the plating cycle without being stripped, reverse current cleaning is recommended.

The surface of the castings should be prepared so that prolonged pickling is not required. We have found that some types of castings can be plated when an acid dip is not used. Even a slight acid dip on these castings leads to noticeably poor coverage. On other castings, a moderate acid dip is not objectionable. Still other castings require an acid dip for satisfactory coverage.

There are cases where sand or shotblasting equipment is not available; in these cases a sulphuric acid-hydrofluoric acid dip is recommended. This combination removes oxides and sand, although the surface is in a less acceptable condition to receive a zinc deposit. On mechanically-pre-cleaned castings a 20% by volume hydrochloric acid dip for around 3—10 seconds is recommended. If sulphuric acid must be used, a 5—8% solution and a dipping time of 5—15 seconds is usually sufficient. After acid pickling the work is removed, given a quick sodium cyanide dip (4 oz./gal.) and after rinsing again, is transferred to the zinc plating solution. Prolonged soaking in the cyanide should be avoided as it will lead to spotting-out on some castings.

Modifying the precleaning, alkaline cleaning, and pickling procedures as outlined above have little effect upon the ability of many castings to accept zinc. In our experimental work we have approached the problem from two directions and have been successful in both cases. First, we attempted to alter the plating solution so that the electrochemical conditions at the cathode would be changed, or in other words, the overvoltage at the cathode face would be raised. Secondly, we attempted to treat the castings so that foreign matter on the surface responsible for the preferential discharge of hydrogen in the zinc bath would be completely removed.

Considering the first method, it was found early in our work that sodium carbonate, a constituent normally present in alkaline zinc solutions, had an unmistakably beneficial effect. Castings that would accept no zinc whatsoever could be completely covered if a certain quantity of sodium carbonate were present. The minimum concentration recommended is 5 oz/gal. Sodium sulphate in concentration of over 10 oz/gal. also produced excellent results, although there is danger of adding this salt where the use of calcium sulphate carbonate remover is contemplated.

While using these salts permitted the plating of many castings other-

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wise unplatable, there were many castings gathered from various sources that could not be covered. The addition of colloids such as glue, natural gums and resins, and also modern brightening agents produced further improvement in the controlled-carbonate solution but satisfactory results on all castings were not obtained until it was found that a high-current density strike in a bright, carbonate-containing solution changed the cathode potential sufficiently to permit uniform and complete zinc deposition.

The strike in this case had the following composition:

| | |
|---|---|
| Zinc cyanide | 8 oz/gal. |
| Sodium cyanide | 5 oz/gal. |
| Sodium hydroxide | 11 oz/gal. |
| Sodium carbonate | 5 oz/gal. |
| Ketonic Brightener | 66 cc/gal. |

The striking time recommended is 1–2 minutes and the current density, 125 amps/sq. ft. This current density can be obtained at a tank voltage of 8–9 volts. After striking, the work is transferred to the regular plating solution of identical composition where plating proceeds at the normal current density. By using this system, all grey and malleable castings collected from various sources have been satisfactorily plated. It is probable that bright zinc solutions other than the one mentioned above will yield similar results. Ordinary zinc solutions without brightening or addition agents used as a strike are not effective in all cases and furthermore, do not throw in recesses completely.

The second method of plating grey and malleable castings involves treatment of the castings before going into the plating cycle to remove graphite, ferrosilicon and other constituents normally present.

It was suggested to us by a well-known metallurgist that a molten caustic soda treatment would produce a surface receptive to zinc. When tried, the results were far from perfect, although improvement was observed. By incorporating about 10% of another alkaline salt with the fused caustic soda, all types of castings plated perfectly.

The procedure involves a ½–3 minute immersion in the molten salt bath at a temperature of 725° F, the melt being heated by gas in a cast-iron pot. The castings are then rinsed in warm water and given a short anodic electrocleaning. After rinsing, the work is dipped in a 20–30% by volume hydrochloric acid, rinsed, cyanide dipped and then transferred

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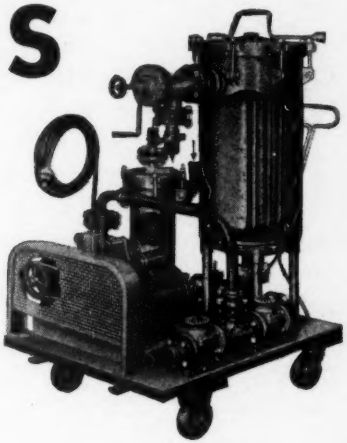

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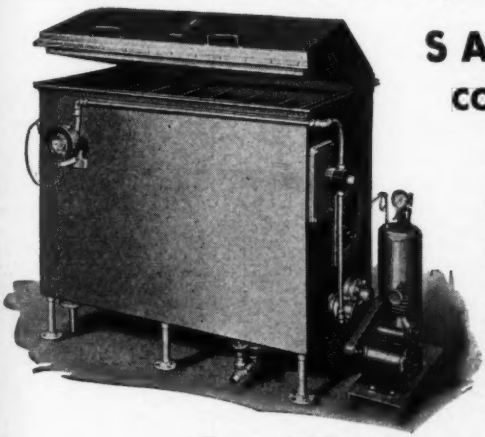

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For testing—Electroplated or coated metals at 95 deg. Fah. in accordance with Army, Navy and Aeronautical specifications, as outlined in Bulletin AN-QQ-S-91-5 dated Dec. 1938. Also for controlled temperatures at any degree. Testing Cabinets lined throughout with rubber. Made in 4 sizes.

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to the zinc plating solution. Any well-balanced zinc bath can be used for plating but bright zinc solutions throw into recesses deeper than ordinary dull plating solutions.

The third method of plating castings was developed within the past few weeks. It is an electrolytic pickling process using a simple neutral salt solution. The castings are electrocleaned as usual, rinsed, acid dipped and then anodically electropickled for ½—4 minutes at a current density of 25—75 amps/sq. ft. They are rinsed, dipped in a sodium cyanide solution and then transferred to an ordinary cyanide zinc solution or a bright zinc solution. No heating is required and the solution can be held in an unlined wood tank.

Unlike acid electropickling processes, smut is not formed on the surface of the work being treated. The surface is slightly etched however and the lustre of the deposited zinc is not as high as when using the carbonate-containing high current density strike. Investigation of the solution is continuing.

In plating castings it is not generally recognized that the actual surface area of a casting may be larger than the apparent area as measured with a ruler or other device. In plating castings it is advisable to use as much as 50—75% more current on the work than would be indicated by usual surface measurements. This is borne out by the fact that thickness measurements of deposits made on castings are appreciably lower under a given set of plating conditions than when polished or cold rolled metals are plated. We have checked this further by plating castings at the correctly calculated current density (from physical measurements) in a solution having a very narrow bright plating range, namely, 10—15 amps/sq. ft. It was found that the deposits were only semi-bright. Raising the current to around 25 amps/sq. ft produced bright deposits. Plating at this current density on cold rolled steel surfaces would have resulted in burned deposits. Considering the increased area of the castings caused by surface irregularities, the actual current density may have been in this case only around 15 amps/sq. ft.

With predominant interest at present in cyanide zinc solutions, it is not realized by many platers that advances have been made in depositing zinc from other types of solutions.

For almost two years, a new type of acid bath developed in our organization, has been used by one of the steel companies for plating steel strip on a commercial scale. This is the first public announcement of the

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**1 SIMPLE TO USE**
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Harshaw Fluoborate Solution is one of the most conductive of all plating solutions . . . and one of the fastest. For example, it plates three times faster than nickel, whether the solution is used for barrel plating or still plating.

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The extremely high throwing power of this solution, its freedom from fluctuations in composition, and its utter simplicity of operation assures uniformly dense, fine grain deposits. In addition, the bath operates with 100% cathode current efficiency.

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Old hazards of reacting Boric with Hydrofluoric Acid, together with previously required time and trouble are now completely eliminated. With Harshaw Fluoborate, preparation is reduced to just two easy steps — pouring the proper amount of concentrate into the tank, and diluting it with water.

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method which we term the "Rapid Zinc Process." The deposits produced are ductile and even when applied to steel in heavy thicknesses, are capable of withstanding severe deforming without rupture. This feature is particularly important in the manufacture of ridged roofing and in plating wire.

The solution is simple in composition; it contains only two ordinary chemicals—zinc chloride and zinc acetate. No addition agents are required. A simple method of analysis is provided for control.

Depending upon the particular application, ductile deposits of zinc, free from trees and coarsely crystalline growths can be obtained at current densities of 40 to 1000 amps/sq. ft. For depositing zinc on steel shapes of simple design, 40 to 100 amps/sq. ft. can be used. For steel sheets 3 to 6 feet wide, 400 to 500 amps/sq. ft. is possible. For electrogalvanizing wire 1000 amps/sq. ft. is well within the limits of the solution.

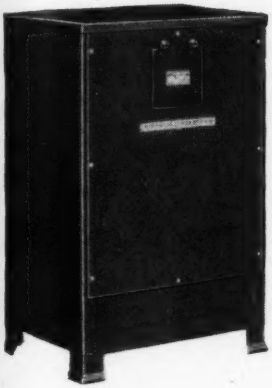
At the recommended anode-cathode spacing, the voltage required for low current density plating (40—100 amps/sq. ft.) is from 3 to 5. For plating wide steel sheets, 5—8 volts is required. For electrogalvanizing wire at 1000 amps/sq. ft. 15 volts are required with an anode-cathode distance of ½ inch.

The optimum operating temperature of the "Rapid Zinc Bath" is 120° F. The temperature is not critical and may be varied between 100° and 130° F.

The operating pH is 3.6 electrometric or 4.1 colorimetric. When the bath is operated with zinc-aluminum alloy anodes, there is no chemical attack when the solution is standing idle.

This feature, in combination with practically 100% anode and cathode efficiencies, and also the inherent stability of the chemical constituents of the bath, results in an almost constant solution pH. The ordinary acid zinc sulphate bath is far from stable in this respect.

In regard to equipment, tanks should be constructed of rubber-lined steel, ceramic ware, or tempered glass. Other linings that are made of non-strategic materials are now being investigated. The solution can be heated from Pyrex Durion or Karbate heat exchangers. Ceramic or Karbate coils can also be used. A filtration unit is required for initial filtrations in preparing the bath. Because of clean corrosion of the alloy anodes, filtration of the operating solution need not be frequent unless the equipment is situated where a large amount of dust and dirt falls



# Solving an Electroplating Problem

*The Problem*

**An Eastern plating company had a contract for anodizing aluminum parts. The contract would be completed in about 9 months. The job would require a power supply of 500 amperes, 40 volts.**

**When, if ever, there would be another job requiring 40-volt equipment was uncertain. Most likely the next job would be low-voltage plating requiring 6 volts. The problem was: What equipment would serve both these widely different requirements.**

*The Solution*

**Here's how the needed flexibility was obtained: Seven standard 500 ampere, 6-volt G-E Copper Oxide Rectifiers were purchased. By a series connection and regulator control, this equipment was adapted to operate over a range from 1 to 40 volts at 500 amperes. When the contract was completed, the same equipment was relocated at two different points so 4 units were used for a plating job requiring 12 volts, 1000 amperes, while the other 3 were set up on a job requiring 6 volts, 1500 amperes.**

**This illustrates only one of the many electroplating power supply problems that can be solved with G-E Copper Oxide Rectifiers. Whatever your problem, General Electric Metallic Rectifier Engineers will consult with you. For additional information, write to Section A234 70, Appliance and Merchandise Dept., General Electric Co., Bridgeport, Connecticut.**

**GENERAL ELECTRIC**

into the solution. Stainless steel or rubber covered filters are recommended.

In the Rapid Zinc Process, particular attention should be given to turbulence or flow of solution. The rate of solution flow depends upon the particular application. A directed discharge from a centrifugal pump or a submerged propeller in a casing which directs the flow, such as the Speed-O-Plate Agitator, produces satisfactory results.

Present conditions have retarded the expansion in use of this process although its use is at the moment being studied in connection with the application of heavy deposits on parts for ordnance. Widespread post war use of the process is predicted.

Another process for zinc plating which is in pilot-plant use, but which has been little publicized is the Hubbell-Weisberg Process. The advantage of this process lies in its ability to use cheap sources of zinc such as galvanizers' skimmings, brass foundry fume, organic reduction residues or ore, by leaching in a solution of ammonia or ammonium chloride. Insoluble graphite anodes are used in the plating tank. Plating reduces the zinc content of the plating solution which is then returned to the leaching plant where the zinc removed by plating is replaced.

The process produces zinc coated wire or strip which is equal to that produced by other zinc plating methods. Steel handling, pickling, and cleaning are the same as for other processes. The plating tank has been specially designed to take advantage of the fact that anodes seldom have to be changed and to provide covers which prevent the escape of ammonia fumes and at the same time permit easy rethreading of wires or strips.

The process works at high current densities and this combined with the high conductivity of the solution and the careful design of the electric equipment from generator to contractor, makes the process economical of electric power.

The real advantage of the process lies in the low cost of the zinc going to the plating operation. This advantage increases as the amount of zinc used increases because a special plant has to be provided to put the zinc in skimmings or other products into solution and the operating costs of this plant must be added to the purchase price of zinc in the plating tank. Depending upon the cost of zinc materials available, the process will not be economical unless from about 1½ to 2½ tons of zinc are required per 24 hours. As the daily consumption of zinc increases above this

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5 papers planned
Tin, Silver, Black, Magnesium, Anodizing

minimum the savings become increasingly impressive. Obviously, this process will not appeal to the average plater but is of tremendous interest to large scale users of zinc such as steel mills.

In conclusion, I would like to call your attention to the fact that surface treatments on electrodeposited zinc are assuming increasing importance. Dr. Meyer has discussed black finishes; government specifications call for passivating dips before painting or lacquering; Bonderizing of zinc for paint adhesion has long been practiced. Recently, the Cronak finish as developed by the New Jersey Zinc Company originally for the treatment of die castings, has been adopted for the treatment of plated zinc surfaces. It is being used on cartridge cases, signal corps equipment, fuse parts, and many other articles entering into our War effort.

It is characteristic of zinc surfaces to corrode with the formation of bulky white corrosion products when in contact with stagnant moisture or under conditions of slow drying. Treatment for a few seconds in the Cronak solution, which is sodium dichromate acidified with sulphuric acid, produces a basic zinc chromate film, which has remarkable inhibiting power. The color of the film varies from an irridescent yellowish-bronze in short treatment to a more uniform brass color upon long treatment. I have seen panels exposed to the atmosphere for over one year without any surface corrosion visible. Untreated panels under identical conditions were covered with bulky white corrosion products. The New Jersey Zinc Company is issuing licenses for the use of this process and will gladly give further technical information to interested manufacturers.

Zinc plating today is not becoming important — it is already important. With the experience accumulated during this trying period, we can predict now that, after the war, zinc plating will find ever-increasing applications and that the quality, protective value and ease of application will reach heights unknown only a few years ago.

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# Supplies and War Production

By W. D. STARR
*of The Lea Mfg. Company*

THE Controlled Materials Plan is beginning to cut its first teeth and to make its influence felt in many directions. Like any new system, CMP will have to prove itself in actual operation before we accept it as the answer to a maiden's prayer. Meanwhile there are assurances that it will go further than PRP toward insuring the right quantity of materials at the right time to satisfy well balanced production schedules.

Most firms have filed the necessary CMP forms covering future requirements. Local field offices of WPB have been most helpful in advising and providing these forms. In many cases they have telephoned firms to make sure they have "CMP'd" on time.

Allotment number or symbols will take their place along with preference ratings to establish seniority. For example, a rating of AA-2X with allotment symbol is superior to plain AA-2X. However plain AA-1 is higher than AA-2X with allotment symbol. This is important to bear in mind as many have believed that an allotment symbol would lift a rating above any other which lacked such qualifications.

There are a few new wrinkles in connection with various supply items. Zinc Anodes can be obtained quite promptly by placing an order rated AA-5 or higher. Zinc is getting more scarce, so deliveries may be slower later on. Primary Chromium chemicals such as Bichromates, can be purchased with less formality now. If more than 500 lbs. per month are obtained, Form PD-54 is filed with WPB by the consumer. Users of smaller amounts are exempt from this requirement. Chromic Acid is moving freely without preference ratings or other credentials.

The Soap supply is effected by allocation of fats under Order M-71. Exempt are non-detergent uses on metals such as burnishing, lubricant for drawing or forming, ingredient of surface treatment solutions, etc. This makes it necessary to specify end use in order to distinguish from soap used for purely detergent purposes. Non-exempt soap is becoming hard to obtain in quantity.

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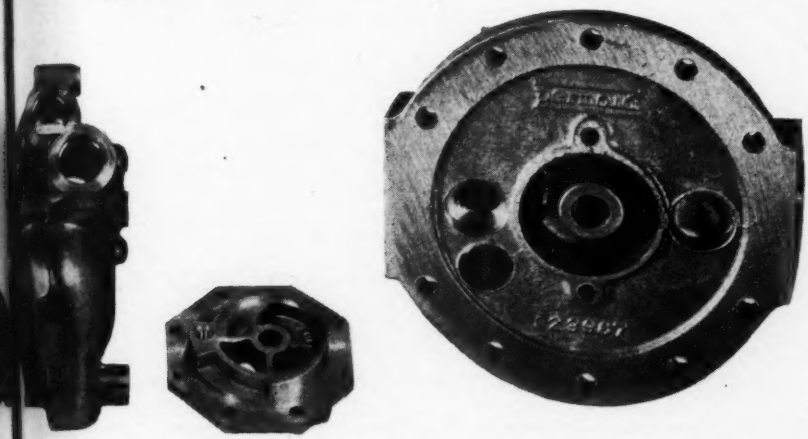
Where does burring come in? It is absolutely essential that every potential tiny particle of metal is removed before the filter is assembled and placed in operation. Should any tiny particles within the filter drop off, they would, of course, defeat the very purpose for which the filter was installed.

Note the many burrs in the castings pictured above. Imagine the task this would be if all the work were done by hand. Imagine

# BURRS...



the difficulty of maintaining tolerances in the measurements, if the burring were done with files or metal burrs.

Here is an excellent example of the way LEA Engineers help manufacturers. Cooperating with Cuno production officials, they worked out a simple, effective and economical method for removing all burrs not only on the castings but on the discs.

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# Problems and Methods for Plating on Magnesium

By JAMES P. ApROBERTS

*Aircraft Processing Consultant*

THERE was, I believe, a time in the history of plating when platers confined the range of their activities to plating and furthermore, they preferred to plate only on certain metals which, at that time, were not subject to man made restrictions. Now, as we all know, today's plater has shown himself to be a very versatile man. Through the portals of his shop there pass a greater variety of items than ever before and the question of the day is not "When can you pay me?" but "How high a priority number can you give me? So with this frame of mind, let us consider the problem and methods of plating on magnesium.

Ordinarily, magnesium parts are not plated but given some sort of protective treatment prior to painting and assembly.[1] However, it is quite likely that with the increasing availability of Magnesium there will be instances where lightness and strength plus the attractive appearance of plated coating will make the use of plated magnesium trimmings, accessories and parts desirable, such as on aircraft. Therefore, let us consider the question of plating on magnesium and be prepared to meet that demand.

The problem of plating on an active metal such as magnesium depends not only upon the use of the correct type of plating solution but also the proper pretreatment. All platers are aware of the fact that many base metals are coated with some characteristic surface film or corrosion product such as the iron oxide or rust found on iron and iron alloy parts. This film may interfere with the adherence of a deposit and have to be removed by pickling or some other type of pretreatment. Then too, there are the usual methods of removing grease, shop dirt and other contaminants in order to provide a receptive surface.

However magnesium not only possesses a characteristic film of magnesium oxide which is a poor base for electrodeposits but it has certain other properties which create a problem of obtaining good deposits on

Presented to the Los Angeles Branch A.E.S., January 4, 1943

it, far greater than that for base metals lower in the electrochemical series such as copper and iron alloys. For instance a cleaned magnesium surface will readily react with water to form a film of magnesium hydroxide by displacing hydrogen in a manner similar to the following equation: $Mg+2H_2O=Mg(OH)_2+H_2$. This is not desirable because it interferes with the adherence of electrodeposits. Furthermore Magnesium is attacked by most acid solutions and when immersed in an electrolytic solution under ordinary conditions electrolysis between untreated magnesium and the other metal ion would result in magnesium displacing the other metal, particularly in neutral or acid electrolytes.

Therefore, from these facts it can be seen that the development of practical methods and solutions for plating magnesium parts was not a simple matter, but the product of much research and experimentation. So I wish to acknowledge that much of the following data was obtained from publications by W. S. Loose[2] and F. J. Bowens[3] and L. I. Gilbertson[4] who had much to do with the present means for nickel and silver plating on this metal. (Electro-chemical Society Preprints 81-6 and 83-1).

[1]Plating and Finishing Guidebook (1942 Ed.) pp. 34ff.

[2]Metallurgist, Dow Chemical Company, Midland, Michigan.

[3]With Mining Experiment Station, The State College of Washington.

[4]Assistant Professor, Department of Chemistry and Chemical Engineering. The State College of Washington.

Possibly aside from the use of solvent degreasing in order to remove any obdurate buffing compound, the first step for either nickel or silver plating is cathodic cleaning in either a suitable proprietary cleaning solution or one of approximately the following composition which is kept at a temperature of between 160 and 190° F. with the higher value preferred.

| | | |
|---|---|---|
| Sodium Carbonate, $Na_2CO_3$-$10H_2O$ ..... | 7.4 | oz./gal. |
| Tri sodium phosphate, $Na_3PO_4$-$12H_2O$ ..... | 14.5 | " |
| Sodium hydroxide, NaOH ..... | 3.7 | " |
| Sodium metasilicate, $Na_2SiO_3$ ..... | 7.4 | " |
| Wetting Agent (such as Sodium or Ammonium lauryl sulfate) ..... | 0.9 | " |

The work is subjected to a current density of between 50 and 200 amp. per square foot for a period of between one to two minutes. After this it is thoroughly rinsed first in hot and then cold water and at this point the similarity between the two procedures ends and we shall have to consider each one separately.

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Nickel plating on magnesium.[5]

The next step in nickel plating is a brief (approx. 5 seconds) etch or dip in the following bath which is operated at room temperature.

+

| | | |
|---|---|---|
| Chromic anhydride, C.P., $CrO_3$ | 15.8 | oz./gal. |
| Nitric acid, C.P., $HNO_3$ (Conc.) | 10.4 | " |
| Sulfuric acid, C.P., $H_2SO_4$ (Conc.) | 0.007 | " |

+

A technical grade of chromic acid may be used providing that its sulfate content is kept at a minimum (note the minute amount of $H_2SO_4$ in the above formula) and the soluble chlorine content of this solution is maintained at less than 350 ppm. If it is above this figure, it may be reduced by the addition of a suitable amount of 0.1% silver nitrate, $AgNO_3$, or possibly merely by changing to chlorine-free make-up water.

The probable function of this chromic acid etch is to replace the magnesium hydroxide film formed during cleaning with a chromate film while the concentrated nitric acid increases the etching action and hence greatly improves subsequent adhesion by giving the surface a more toothed effect. The presence of a small amount of sulfate is believed to modify the chromium oxide film to such an extent that it is more completely removed in the next process.

After a very thorough cold water rinse to eliminate any chromic acid carry-over, the work is immersed in a bath of the following (roughly) composition—for between 1 and 5 minutes at room temperature.

+

| | | |
|---|---|---|
| Hydrofluoric acid, 52% HF | 22 | oz./gal. |
| Nitric acid, C.P. $HNO_3$ (Conc.) | 1.1 | " |

+

Previous experience in the use of HF etches for magnesium surface treatments of other types has shown that the HF concentration should be maintained at about 10% to avoid a more severe etching which can occur from using less concentrated solutions.

[5]Nickel plating magnesium alloys—W. S. Loose, Trans. Electro-chemical Society 81, (Preprint 6) (1942).

At this point it would be well to insert a word of warning regarding the use of hydrofluoric acid baths. The mere fact that lead lined or rubber coated (Koroseal) tanks are required should imply their potency. Regardless of concentration, adequate ventilation should be pro-

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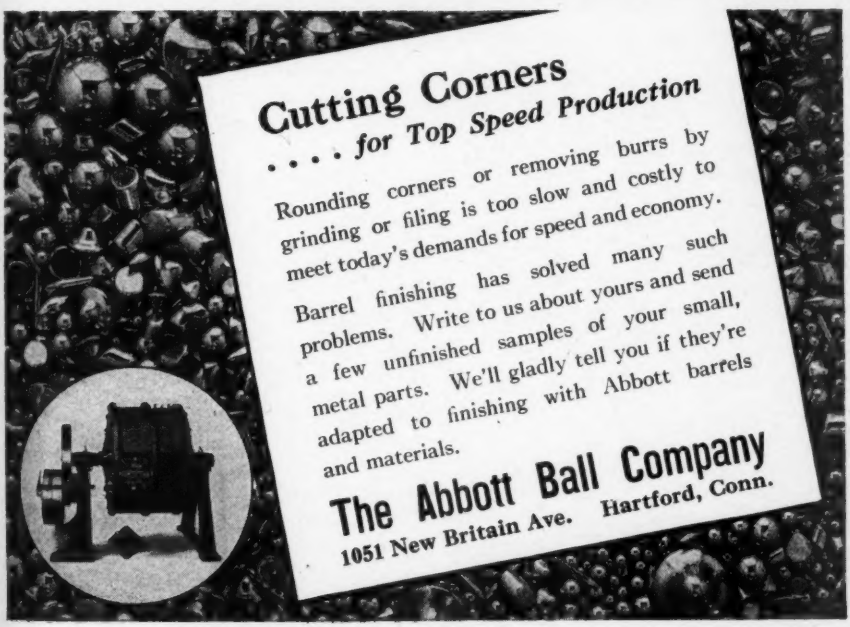
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vided and operators should use rubber gloves and wear protective clothing. Any flesh burns or respiratory difficulties (which may result from failure to observe these precautions) should be treated immediately. The former requires thorough and prolonged washing in cold water and in either case call a physician if a serious burn is indicated by pain, loss of sensation or redness of the skin.

After a thorough cold water wash, the work is ready for plating. Theoretically, the chromium oxide film formed by the etch has been modified or possibly replaced by one of magnesium fluoride that is compatible with the nickel deposited from nickel fluoride baths and which may be entirely removed or replaced during the plating operation by the nickel coating. An additional function of the HF treatment may be to remove any possible oxides formed by the possible action of excess HCL or $H_2SO_4$ in the chromic acid etch.

The following fluoborate solution was found to be the most satisfactory: It should be made up by first dissolving the $NH_4F$ and $H_3BO_3$, enough HF is added (52% HF is suggested) to lower the pH to 5.8–6.0, then the $NiSO_4{:}6H_2O$ is dissolved and further addition of HF is made to bring the pH to 5.5. As a wetting agent which can reduce hydrogen pitting that may be caused by suspended matter the use of a small amount (0.004 oz./gal.) is suggested of Duponol ME.[6]

| | | |
|---|---|---|
| Nickel sulfate, $NiSO_4{:}6H_2O$ | 7.9 | oz./gal. |
| Boric Acid, $H_3BO_3$ | 4.6 | " |
| Ammonium fluoride, $NH_4F$ | 8.8 | " |
| Hydrofluoric acid, 52% HF—to reduce pH to | 5.5 | " |
| Duponol ME | 0.004 | " |

For best results this bath should have an analysis as follows:

| | | | | |
|---|---|---|---|---|
| Nickel, Ni | 1.77 | oz./gal.— | 1.34% | |
| +Boron, B (Total) | 0.80 | " | 0.61 | |
| +Fluoride, F (Total) | 6.58 | " | 5.0 | |
| Excess Boron | 0.158 | " | 0.12 | |
| Excess Fluoride | 0.1 | " | 0.6 | ± 0.2% |
| pH | 5.5 | | | |

+

This analysis is calculated on the basis of the bath being composed of $Ni(BF_4)_2$, and whether or not this condition actually exists, it affords a suitable method of calculating the necessary amount of excess Boron and Fluoride.

It is operated (probably using lead or other insoluble anodes) at a temperature of close to 102° F. and a current density of 10 to 30 amp./sq. ft. It may be assumed that a plating time of 45 minutes will under the above conditions produce a Nickel deposit with a plate thickness of 0.001 in.

[4]Duponol ME is a fatty alcohol sulfate wetting agent developed and sold by E. I. duPont de Nemours & Co., Inc. It does not decompose in this bath.

The characteristics of deposits produced by this method are good adhesion, fair corrosion resistance and smooth surfaces, relatively free from pitting.

I might enlarge upon the adhesion values reported and state that, using a tension set-up similar to the method developed by Ollard and later modified by Rehl, a value of about 30,000 lb./sq. in. was required to remove the deposit force.

Another interesting adhesion test used consisted of making two scratches through the deposit at approximately a 30° angle to one another and determining the difficulty of lifting the plate with a pointed tool. The results showed that a good deposit would break off, not independently, but with a portion of the base metal adhering.

Unsatisfactory nickel coatings can be easily stripped in a solution of about 25% hydrofluoric acid, HF, and 5 to 10% nitric, $HNO_3$. In this method the work is treated anodically at a wide range of current densities and as the nickel goes into solution, the magnesium completely

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polarizes due to the formation of magnesium fluoride, $MgF_2$. When the current drops to zero the work has been completely coated with this film. It may then be withdrawn, thoroughly washed in cold water and re-plated in the nickel bath.

For the best corrosion resistance, a triple plate: nickel, then buffed cadmium and buffed nickel (to reduce porosity) with a total plate thickness of 0.001 to 0.0015 in. has been found to withstand about 20 hours of salt spray before the onset of pitting. At present, nickel plated magnesium alloys with a plate thickness of 0.001 inches may be safely used in atmosperes protected from excessive moisture. Probably better results could be obtained by applying a further protective coating of a clear phenolic resin varnish which could be baked or forced air dried to improve adhesion and durability. It should always be remembered that a scratch or cut through the plateon the magnesium will provide an opportunity for electrolytic action.

Having reviewed the subject of nickel plating let us now consider silver plating.[7]

The second step in preparing magnesium for silver plating consists of an anodic treatment in a 25% solution of Trisodium phosphate ($Na_3PO_4.12\ H_2O$) operated at 140 to 175° F. with a current density of 275 to 375 amp./sq. ft. for 3 to 6 minutes. This treatment forms a smooth gray film on the surface which is stable and adherent. It is followed by a cold water rinse.

No supposition regarding the nature of this film nor the part which it plays in the following plating treatments was made by the investigators[7]. However, it may be that a film of magnesium phosphate is formed which is either dissolved or acts as a suitable base for the subsequent copper strike replaced by film formed in the next step.

This copper strike is of the following composition:

| | |
|---|---|
| Copper cyanide | 0.67 oz./gal. |
| Potassium cyanide | 13.3 |

It is operated at room temperature (68 to 77° F.) Time of treatment depends upon the condition of the surface in order to completely cover the magnesium with copper. Generally, anywhere from 1 to 30 seconds at a c.d. of around 270 amp./sq. ft. is required. After a thorough cold water rinse, the work is ready for silver-plating which is done as follows:

Using high purity silver anodes (anode-cathode ratio should not exceed 1:6 because larger anode areas shorten the solution life and

produce poor deposits) the work is treated at a fairly low c.d. of 1.8 to 4.3 amp./sq. ft. in a bath operated at room temperature (68 to 77° F.) and made up as follows:

| | |
|---|---|
| Boric acid | 1.3 to 4.0 oz./gal. |
| Silver cyanide | 1.1 oz./gal. |
| Potassium cyanide | 1.5 |

Evaluation of the films poduced by this method showed that they were quite familiar to ordinary electro-deposited silver plates except that their porosity rendered them unsuitable for protection of the magnesium surface. No measurements of adherence were noted although natural adherence as opposed to the development of blisters was remarked upon in the paper by Bowen and Gilbertson.[7]

[7]Silver plating magnesium alloys — F. J. Bowens and L. I. Gilbertson, Trans. Electrochemical Society 83, (Preprint 1) (1943).

Summary:

In either case the principal object of nickel and silver plating upon magnesium was to secure coatings which would give a fair degree of corrosion protection but principally secure those other properties of nickel and silver plating—namely, lustrous appearance, a hard durable surface and the advantages of being able to use an extremely light metal as a substitute for articles formerly made of heavier metals. The references discussed herein have undoubtedly thrown considerable light upon the mechanism necessary to plate active metals.

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# Masters' Electro-plating Association

**February — 1943**

THE rate of operations for February was 72% compared with 67% in January and 76% for January 1942. Business is growing steadily and now approaches 1942 volume.

The following letter was received from W.P.B. directed to electroplaters, galvanizers and other metal coaters:

In response to numerous inquiries, this letter is intended to clarify the status of your industry under the Controlled Materials Plan. Contrary to the general impression, you are not considered as an "A" producer since the instruction sheet accompanying Form CMP-4B specifically states that this Form is to be used by all *service shops* as well as research laboratories and repair shops. (See CMP-4B General Instruction Number 7.)

Therefore, to obtain production material in the form of controlled materials for the second quarter of 1943, you should file form CMP-4B, if the amounts of such material are greater than can readily be obtained from warehouses as provided for in CMP Regulation 4.

For the interim period, until you receive your allotment on Form CMP-4B, you may operate in accordance with Priorities Regulations 11 and 11a during the second quarter provided you are a PRP unit. If you are not a PRP unit, you may, during the interim period, operate by extension of rating in accordance with Priorities Regulation 3, or by applying on Form PD-1A.

The means for securing maintenance, repair and operating supplies is provided for in CMP Regulation 5.

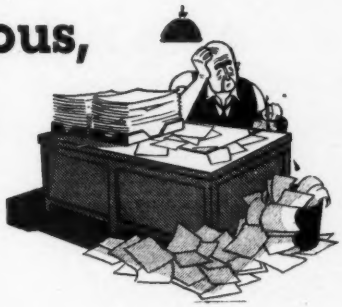
For manufacturers, operating a Plating Department within their plants and plating their own products, the plating requirements will then be handled on an "A" product basis. The small order provision of CMP regulation 1 may be used by these manufacturers for obtaining limited requirements of controlled materials.

After June 30, 1943, it is mandatory that you secure your controlled materials under the Controlled Materials Plan. Therefore, it is recommended that you familiarize yourself with the regulations and instructions of the Controlled Materials Plan.

Very truly yours,

SERVICE EQUIPMENT DIVISION
D. M. CRIM, *Chief*
Repair and General Services Section

# It's strenuous, this being a citizen



THE perennial pain of the tax return is one more reminder of the responsibilities of being a citizen. No man lives to himself; or for himself alone. What he acquires he shares, and once a year he makes an accounting.

Business has its responsibilities, too. Not the least of them these days is to be thrifty of man hours. Stortsweldmanship does that. The essence of it is being sure that there are no service failures to harass busy executives who are already carrying full loads.

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# BRANCH NEWS

***Business and Social News · Educational Activities***

## LOS ANGELES VICTORY MEETING

March 20th is the date and Los Angeles Elks Club is the place for the Victory Meeting to be held by Los Angeles Branch.

Chairman Marcus Rynkofs says the following reasons assure in advance the success of the big affair. The meeting is to increase plater's knowledge of surface treatment of metals used in the War Effort.

Educational session starts at 10 P.M. A star studded program is all set, with papers to be presented by B. D. Dow of La Salco, Manuel Sanz (Proctor Award Winner) of Vultee Aircraft, Dr. Herbert Waterman, and Harold Acher, Chief Chemist of W. P. Fuller Co.

There will be fun for everybody with dancing, dining, souvenirs, special events and entertainers. So come one, come all. A grand time is as sure as taxes.

James P. ApRoberts

### BUFFALO BRANCH

The regular meeting of the Buffalo Branch was held in the Hotel Statler, January 15, 1943 at 8:00 p.m. In the absence of Joe Ruff, Dr. Wernlund took the chair and introduced the speaker of the evening, Mr. Lankau of the Egyptian Lacquer Company who spoke on the topic "Lacquers and Synthetic Enamels as Substitutes for Plated Finishes".

Mr. Lankau pointed out that lacquers and synthetic enamels were not originally intended as substitutes for plated finishes. Clear lacquers are used extensively as protective coatings for plated finishes and synthethic enamels are used to impart special finishes with specific characteristics which make them suitable for the objects to which they are applied. Organic finishes for war work may be considered a branch of the previous industry which produced organic finishes for civilian and commercial use.

A war finish must meet certain basic requirements which distinguish them from the original organic finishes. They must be made at low cost from readily available material. They must cover and protect with a minimum number of coats. They must be adaptable to fast production. They must also fulfill certain specifications for the specific job for which they will be used.

Mr. Lankau went on to enumerate some of the headaches of the paint manufacturers in supplying lacquers and enamels for the Army and Navy. The specifications for Army finishes are different from those for the Navy, thus making necessary the maintenance of two separate sets of specifications. An attempt is now being made to coordinate these two branches so that one set of specifications will cover the requirements of both.

Methods of application can be divided into 7 classes: spraying, dipping, brushing, pouring, flooding, roll coat, and centrefuge. The method to be used in any specific case depends on the nature of the article and the use to which it is to be put. Two important factors in the application of organic finishes are temperature and viscosity. Optimum temperatures are between 70° and 80° F., the higher limits being more acceptable. The proper viscosity depends upon the method of application, and once established it should be maintained. The simplest method of checking the viscosity is to have two glass tubes of equal cross-section and length. One is filled with material of proper viscosity and stoppered, leaving a small air bubble. Subsequent batches are adjusted to the same viscosity by using the second tube and comparing the time required for the entrapped bubbles to rise after inverting the tubes in unison. For accurate results the tubes should be no less than 12" in length.

Mr. Lankau answered numerous questions by the members and was given a rising vote of thanks for his excellent talk.

Joe Ruff, having come in during the talk, took over the meeting for the business session. The minutes of the previous meeting were read and approved as was the treasurer's report.

A meeting of the 1943 Convention Committees was scheduled to be held at 7:30 p.m. Tuesday night, February 2, 1943. Dr. Wernlund gave us a report on the activity of the educational committee for the National Convention. There is no question but that a really instructive and interesting program is to be available.

The meeting was abjourned at 11:00 o'clock.

JAMES C. MAYS, *Secretary*

### TORONTO BRANCH

The regular meeting was held in the Royal York Hotel, Feb. 11th with President Boaz in the chair. There was a good attendance with Mr. Stevens, Mr. Snelgrove, Mr. Stewart, and Mr. Guffey as visitors who joined in the fun of the evening, the feature being, "Information Please."

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Four new applications were received. All arrangements were made for the Annual Dance, Feb. 12th, and the Card Party to be held March 19th.

A letter was read from Mr. Darwin of Peterbourgh, Ont., requesting the set-up for high speed silver sol., operating 70 to 300 amps., with 10 oz. metal per gal. Any member who knows anything about this should get in touch with Mr. Darwin. Mr. Arthur West said he had heard of such a sol. and thought it was a patented one and suggested to write Mr. Meslie.

"Information Please" came under the heading of Good and Welfare. The questions came from President Boaz, Secretary Harris and Trustee Byers, with Messrs. Acheson, Graham, and Cairns as judges. Eighteen prizes went to the best answers. Members were asked to elaborate and give practical explanations. This was a real educational session with everybody having something to say and playing a part such as system of operations, etc. Questions were on Ni, zinc, cadmium, silver, copper, chrome and especially hard chrome as operated under war production on files, dies and punches,

degreasers and cleaning solutions, chrome strips. The how and the why of information came out without being asked for.

The outstanding answers were from Arthur West of Vaughn, W. Price, J. McZean, C. Kemish, Brock, Fitzsimmons, O'Keefe, Crighton, and Mr. Guffie culminating a very pleasant evening.

Meeting adjourned at 10:45.

JAMES S. CAIRNS, *Secretary*

## HARTFORD BRANCH

The February meeting of the Hartford branch of the American Electro-Platers Society was held Monday evening, February 15, at the Hartford Electric Light Company, 266 Pearl Street, Hartford, Connecticut.

Two men were elected to membership —Mr. Daniel Toce, and Mr. Harry Sanders. The application of four men was accepted—Anthony Frascarella, Harold J. Dooley, Harold Bishko, Earl B. Lewis. The transfer of Arthur Logozzo from Springfield was noted.

It was announced that the regional convention will be held in Hartford the first Saturday in May.

A very interesting talk on the protection of steel by coatings of zinc and cadmium was given by Mr. I. Laird Newell.

It was pointed out that approximately 2% of the iron and steel produced today is lost by corrosion and that zinc and cadmium have been found outstanding for the protection of iron and steel surfaces.

Cadmium occurs as a by-product in the mining of copper, lead, and zinc 80% of which goes into the electroplating field, whereas only 1% of the zinc mined goes into the electroplating field.

An explanation of the electromotive forces involved of various plated metals was given. It was pointed out that zinc and copper are electro-negative to steel and therefore protect it. Whereas, copper being electro-positive, increases the corrosion of the base metal.

Zinc forms insoluble corrosion products whereas cadmium forms soluble corrosion products which also may be deliquescent. Cadmium has good throwing power compared to zinc. The corrosion products of zinc are deleterious to cotton goods; therefore fittings plated with this metal cannot be used around rope or sail cloth. Cadmium does not possess this disadvantage. Cadmium is better in contact with duralumin in the aircraft. Zinc is not a good conductor as cadmium when its corrosion products are taken into consideration. An interesting factor in considering the two metals is that the rates of corrosion in industrial atmosphere are similar to the atomic weights.

Three movies were presented at the end of the talk.

K. P. BELLINGER, *Secretary*

## DETROIT BRANCH

The Regular meeting of the Detroit Branch was held on Friday, February the 5th. This meeting was called to order by President J. E. Fritts.

Several applications for membership were received, and fifteen applications were approved by the Board of Managers. This is a good indication that the plating industry is finding new outlets for its energies in the war effort.

The members were then presented with a very interesting and instructive movie entitled, "Exploring with X-ray" which was provided through the courtesy of the General Electric Company.

President J. E. Fritts then presented the speaker of the evening, Mr. E. W. Schweiker of the E. I. duPont deNemours Company. His subject was entitled, "The Lead Sulfamate Plating Process.

At the close of his talk Mr. Schweiker was asked numerous questions concerning the practical operation of the bath, which he answered as fully and as completely as possible. The round of applause given at the close of his talk indicated an active interest in the subject and an appreciation of its splendid presentation.

We were quite pleased to see a record attendance of over one hundred members and guests present to hear Mr. Schweiker present his discussion on Lead Plating.

The meeting adjourned at ten-thirty p.m.

WRIGHT W. WILSON, *Acting Secy.Trea.*

### BALTIMORE-WASHINGTON BRANCH

The first 1943 meeting of the Baltimore-Washington Branch of the A.E.S. was held on January 9, at the Republic Restaurant. Forty-one members and guests were present. As the table service was a trifle slow, President Warnock saved time by conducting the business session between courses. Minutes of the previous meeting were read and approved. Mr. Slattery reported for the committee which is investigating the enlarging of the Society's scope. He read a letter on the subject by the Newark Branch. The Banquet committee reported.

For the first time in many meetings, no new membership applications were presented.

For the program, Librarian Lamb presented Mr. K. W. Schwartz, vice-president of the United Chromium Corporation, who read a paper on "'Industrial Chromium Plating". Detailed information was given on the practical problems of plating various kinds of tools, and the members showed a great deal of interest in the subject.

The only difference between hard chromium plating and decorative plating is that hard plating requires a greater thickness of chromium. The plating conditions are about the same. For hard chromium coating the base metal must be hard enough to support the chromium deposit. For drills, reamers, mandrills, etc., a hardness of 60-65 Rockwell C suffices. The thickness of chromium plated on cutting tools depends on the type of material to be cut. Chromium plated tools are most satisfactory for cutting nonferrous materials. On the other hand, a chromium plated tool may not be satisfactory for cutting some hard steels. Files are plated at a current density of 4 to 5 amperes per square inch of superficial area, at 110° F. for 5 min. Thick deposits are to be avoided. Twist drills are given a thin coating by plating 5 to 20 minutes at 131° F. with a current density of 1 to 2 amp/in$^2$. Many steel parts are given a heat treatment after chromium plating. Reamers are plated with 0.0001 to 0.0005 inch of chromium. Drawing plugs and dies with 0.0025 inch. Rolls, drums and rams may have from 0.004 to 0.012 inch of chromium.

The Baltimore-Washington Branch held its Annual Educational session and Banquet in Washington, D.C. at the Lee Sheraton Hotel, on February 6, 1943. The banquet and entertainment was thoroughly enjoyed by the 105 members and guests who were present. The educational session, which was held in the afternoon was attended by 55 people. The attendance at both the banquet and the educational session was above average for this Branch.

At the afternoon session, the first speaker on the program was Mr. James T. Kemp of the War Department, Service of Supply, who spoke on "Availability and Uses of Metals". Mr. Kemp pointed out that at present less emphasis was being put on substitution and more emphasis on a balanced allocation of available materials. The availability of different grades of zinc is in inverse proportion to their purity. High-grade zinc for cartridge brass is scarcest, while zinc for galvanizing is the most readily obtainable. The 1943 production of aluminum will be 3½ times the 1941 production, but the 1943 production of cadmium will be only 20 percent more than the

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1941 production. An effort is being made to substitute zinc for cadmium. An ample supply of lead is on hand for plating and dipping and an increased use of lead coatings is desirable as a substitute for zinc. The armed forces will require 36,000,000 items of tableware, requiring 4,000 tons of metal. The selection of suitable coatings for steel tableware is an acute problem.

Mr. Richard Dimon of the Carnegie-Illinois Steel Corporation spoke on the "Electrolytic Tinning of Strip Steel". He gave details of the process and illustrated with slides. The audience was impressed by the magnitude of the plant operations and by the large number of automatic devices used for inspecting the sheet steel and tinned coatings. It is expected that both of the papers will eventually be published in the Review.

The last speaker on the program was Mr. Gustaf Soderberg of the Udylite Corporation, who spoke on "Properties of Plated Lead Coatings". Mr. Soderberg has made an exhaustive survey of the literature on the corrosion of lead. Most of the data was from English sources. Lead coatings 0.001 inch thick protected steel exposed out of doors for 3 years without any rust appearing. Lead does not accelerate corrosion of steel, but in some cases exerts a slightly sacrificial action. Mr. Soderberg's paper will be published by the American Society for Testing Materials.

ABNER BRENNER, *Secy.-Treas.*

## NEWARK BRANCH

The first meeting for 1943 of the Newark Branch of the A.E.S. was held on Friday evening, January 8th, 1943 at the Hotel Robert Treat, Newark, New Jersey. The meeting was called to order at 8:30 p.m. by President William Bruhns. The only two officers not present were Robert R. Sizelove and John B. Kotches, both of whom are in the hospital.

Due to the fact that 120 members and visitors were present to hear our Guest Speakers for the evening the regular routine of business was dispensed with. The speakers, Dr. Engel and Mr. Cohn, were introduced by our Librarian, William T. Maguire. The speakers represented Colonial Alloys Company of Philadelphia. They brought with them all their equipment, such as Jars, Meters, Rectifiers, Solutions and Chemicals and gave us a practical demonstration on how aluminum was being electroplated and anodized and also electroplated upon other metals and alloys. They told us of all the advantages of this method for certain limited articles. Their talk and demonstration lasted until 11:30 p.m. The speakers were given a rising vote of thanks.

The following applications were voted to take the regular course. Harold S. Kelshaw, James J. Allen, Eugene M. Silverback and Charles E. Bloom, all to Associate Membership.

Herbert E. Millwater was elected to Associate Membership. All Committee Reports were held over for the next meeting.

The meeting was adjourned at 11:45 p.m.

GEORGE WAGNER, *Secretary*

## NEWARK BRANCH

The second January meeting of the Newark Branch of the A.E.S. was held on Friday evening, January 22nd, 1943, at the Hotel Robert Treat, Newark, New Jersey. The meeting was called to order at 8:30 p.m. with President William Bruhns in the chair. Other officers present were: George Wagner, Secretary-Treasurer; William T. Maguire, Librarian; Horace H. Smith and Paul A. Oldam, Board of Managers.

The minutes of the previous meeting were read and approved.

Letters of Appreciation for the Newark Branch Year Books from the following Branches were read and placed on file:—Baltimore-Washington Branch; Montreal Branch; Detroit Branch; Hartford Branch; Pittsburgh Branch; Chicago Branch; Philadelphia Branch; Dayton Branch and Cleveland Branch.

President Wm. Bruhns read a letter in answer to his letter to all Branches. Mr. Horace H. Smith read the report for the Christmas Party which showed a small profit for the first time. He and the President next reported on the condition of John Kotches and Bob Sizelove who are still confined to their homes. A motion was made, seconded and carried that a collection be made to send flowers or fruit baskets to both members.

Our Librarian remarked against the practice of concerns who supply speakers for our meetings and advertise among their customers or prospective customers to send representatives to attend our meetings without the consent of the Branch. Mr. Horace Smith moved that this problem be held over for the next meeting.

There being no guest speakers, our Librarian selected three groups of experts to sit at the head table to answer questions which were brought before the floor. This idea created quite an interest and many questions were asked and answered. The experts were given the customary rising vote of thanks by the 37 members who attended.

The meeting was adjourned at 11:00 p.m.

GEORGE WAGNER, *Secretary*

### CHICAGO BRANCH

The 31st Annual Educational Session and Banquet of the Chicago Branch was held Saturday, January 23, 1943, at the Palmer House. There were 325 in attendance at the educational session.

Dr. W. Meyer, Technical Director of the Enthone Co., spoke on "Blackening of Ferrous and Non-Ferrous Alloys."

Mr. M. B. Diggin, Chief Chemist, Hanson-Van Winkle-Munning Co., spoke on "Recent Developments in Zinc Plating."

Dr. C. L. Faust, Battelle Memorial Institute, Columbus, Ohio, spoke on "Deposition of Alloys."

All the speakers made very interesting and instructive talks and answered many questions asked by those present which made this one of the finest educational sessions ever held by the Chicago Branch.

There were 647 dinners served at the banquet, which took place at 7 P.M. in the Grand Ballroom. The music and entertainment were fine and enjoyed by all present. Our National Second Vice-President, Mr. M. R. Caldwell, of the Grand Rapids Branch, was present, as well as members and guests of other branches. Among the branches represented were Cleveland, Detroit, Anderson, Newark, Boston, Waterbury, Milwaukee, and St. Louis. We were surely pleased to see them all.

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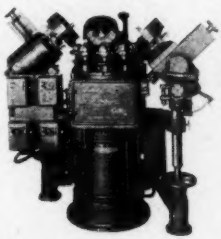

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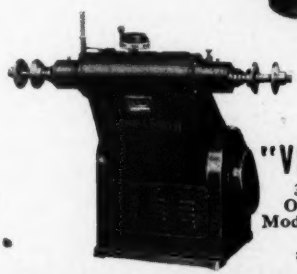

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The Banquet Committee wants to thank the speakers, the members, guests, and the various Supply Companies for their loyal support of this annual event.

J. W. HANLON, *Secretary*

## BRIDGEPORT BRANCH

The regular monthly meeting of the Bridgeport Branch of the American Electroplaters Society was held Jan. 8, 1943 at 8:00 P.M. at the Chamber of Commerce Rooms, Stratfield Hotel. 1st Vice President A. R. McNeil opened the meeting with 21 members present.

The roll call of officers was read and President Charles McElroy and Chairman of the Sick Committee, F. B. Gotthardt were reported absent. The minutes of the previous meeting were read and accepted.

Technical Session Committee wishes to report under the heading of "Good of the Order."

Sick Committee reports Bill Flaherty doing fine and asks members to visit him. No other report.

Membership Committee has no report to offer at this time, but does mention progress is being made.

A card of appreciation was received from the Proctor Family. The members of the Branch stood up in silent reverence in memory of Charles Proctor, who was beloved by all who knew him.

A new type of cut has been received from Jack Bain, publisher of *The Monthly Review*.

A letter from the Newark Branch regarding the amendment to the Society, a motion was made and passed to inform the Newark Branch that the members of the Bridgeport Branch have decided definitely to take action on this matter.

In reference to the letter from E. T. Candee regarding the change of name of the Society, it was voted to send a letter to each member of the Branch with complete details and ask for their comments by mail or in person. This will enable the Branch to get a better understanding and viewpoint from all the members of the Bridgeport Branch. A thorough discussion is expected at the next meeting.

J. R. Griffith from 1086 King St., West Hamilton, Ontario, Canada, sends his resignation as a member of the Branch giving reason of poor health and no longer connected with the plating business. Resignation accepted by the Branch.

Bills against the Branch were ordered to be paid.

After a thorough discussion, the members felt that we should have one meeting each month instead of two until further notice. Various reasons were expressed for this and all agreed that this was the proper thing to do in the face of current conditions.

The treasurer's report was read and accepted.

The Educational Session was turned over to our Librarian, C. C. Helmle, who entertained us with pictures with our film projector in operation and were enjoyed by all members present.

The meeting adjourned at 11:00 P.M.

JOSEPH G. STERLING, *Secy.-Treas.*

## CINCINNATI BRANCH

The Cincinnati Branch, A.E.S., held its January meeting at the Hotel Gibson. The meeting was opened by Harry Misner, who gave a short talk on the activities of the Branch and its many sources of information open to its members. He also introduced Mr. Mace of the Council of Engineering and Technical Societies, of which the Cincinnati Branch is a member, and Mr. Mace explained advantages of his society available to A.E.S. members.

A motion was made that the Cincinnati Branch have a regional meeting the last of March. We hope for a good attendance and anyone wishing information about the meeting should write to the Cincinnati Branch. Plans are not yet complete but more information will be given in next month's *Review*.

Our speaker of the evening was Mr. Harold Ransburg, who spoke on "Electrodeposition of Paint." The speaker was the winner of last year's Proctor Award and his talk was most interesting to our large gathering of members and visitors.

Our very hard-working Librarian, Mr. Ehlen, has been obtaining so many good speakers, nobody can afford to miss a meeting. His work. and Harry Misner's together have been very helpful in securing new members. We are sending in a few more applications, just for a start for the new year, hoping other branches are doing the same.

AL. FOREMAN, *Secretary*

### MILWAUKEE BRANCH

The January meeting of the Milwaukee Branch was held January 8th at the Republican Hotel. The meeting was called to order by our First Vice President Robert Steuernagel, Jr., as President Rodney Olsen is in the hospital.

The minutes of the previous meeting were read and approved as read. Committee reports were read and placed on file.

The membership voted to hold our annual educational meeting and banquet at the Hotel Schroeder the last Saturday in April.

The educational meeting was lead by Librarian William Geissman who introduced Mr. J. A. Laskin of the Udylite Corporation. Mr. Laskin spoke on "Cadmium and Zinc Plating."

1. He explained that the shortage of cadmium was real and showed the necessity of changing to zinc. He displayed samples of dichromate dipped zinc and these samples were proof of the effectiveness of the dichromatic dip in retarding the corrosion of zinc.

2. Mr. Laskin reviewed the need for a thicker coating of zinc if it is used to replace a cadmium coating. He also said that not all cadmium plated parts can be reverted to zinc plating since it all depends on the article and use.

3. Mr. Phil Ritzenthaler showed samples that were dipped in a 5% chromic acid dip. These samples retained the color of the zinc and still retarded corrosion. Although Mr. Ritzenthaler could give no definite information as to compared value to dichromatic dip, the chromic acid dip offers possibilities.

4. Mr. Ritzenthaler stated that the Cutler Hammer Corporation had already changed a large percentage of cadmium plated articles to zinc.

5. Mr. William Geissman said that the zinc color can be retained with the dichromatic dip if the article is dipped in a reducing solution such as sodium thiosulphate to reduce the hexa valent chromium.

Then the members and guests were entertained by Major R. F. McGuire and some of the men in his Company. They demonstrated the technique of personal combat and it was an excellent exhibition of the training our boys in the armed services are receiving. I'm sure if these

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fellows are a sample of our army we have little to fear from any enemy. Major McGuire, a Milwaukee Branch member for several years, took a personal part in showing different ways to fell the enemy.

A rising vote of thanks was given Mr. Laskin and Major McGuire.

Lunch and refreshments were served and the meeting was adjourned.

JAMES DURNFORD, *Secretary*

### WATERBURY BRANCH

Waterbury Branch held its regular monthly meeting January 8th, at the Hotel Elton. Dinner was served at 6:30 P.M. in the Colonial Room and at 8:00 o'clock President Ralph Colter opened the technical session with sixty-four members and guests present. We were pleased to note that quite a few members of the American Society of Metals accepted our invitation and we trust they found the evening profitable. The Board of Managers having approved of the application, it was voted to accept Clyde D. Michaels as an associate member of the Branch.

Ellsworth Candee brought up the question of a regional meeting this year. Although transportation is difficult it does seem advisable to hold such a meeting as new developments are taking place rapidly and can best be discussed at such a gathering.

Bill Starr discussing priorities stated that there is plenty of low grade chrome ore available from which chromic acid is made. Lead is the most available of any of the metals so there is a plentiful supply for anodes, although tin and antimony which are used in an alloy with the lead are scarce. Sulphuric acid is one of the easiest acids to obtain, although at present on allocation. It would seem from this picture that the hard chrome plater does not at present have to worry about supplies.

George Dubpernell reviewed two books published by the American Society for Metals. The first, entitled "Surface Treatment of Metals" is a symposium and treats in a very effective manner all the various methods of protecting metals by surface coatings. The second, entitled "Inspection of Metals" by Harry B. Pulsifer is an elementary review of the subject. It contains a chapter of particular interest to the electroplater on coatings and corrosion tests.

Two very interesting moving pictures were shown giving us an idea of how the B26 Army Bombers and the M3 tanks are manufactured and the tests they pass through before they are put into service.

Bert Sage as Technical Chairman engineered all these various activities in his usual efficient manner and then introduced the speaker of the evening, Meyer Shacat of United Chromium Corp.

Meyer did an excellent job, covering the subject "Hard Chrome Plating, Methods, Application and Value to the War Production Effort." Going into the details of metal preparation, current densities, solution composition, racking, thickness of deposits, etc., he traced the best procedures for different types of work, suggested applications for hard chrome plating and considered the results to be expected from its use. There is no doubt that every one really learned a great deal about this important subject and all present very much appreciated the opportunity of hearing such an illuminating talk.

Meeting adjourned at 10:30 P.M.

S. L. HENN, *Secretary*

### CHICAGO BRANCH

The Chicago Branch regular monthly meeting was held Friday, Feb. 12, 1943, at the Atlantic Hotel.

President F. K. Savage presiding and all other officers present.

Mr. H. Smallman made his report on the annual educational session and banquet. and President Savage discharged the Banquet committee with a vote of thanks.

A letter from Mr. W. Erskine our second Vice President read, outlining the educational session and dinner dance to be held on March 20th at Rockford, also inviting all those interested to attend. Tickets $2.50 each. It is not necessary to buy a ticket to attend the educational session.

Mr. Mattacotti, our Librarian, introduced the guest speaker of the evening, Mr. A. E. Lundbye, Chief Engineer of the Crowell-Collier Publishing Company, of Springfield, Ohio, who made a very interesting and instructive talk on "Tool Conservation—by Chromium Plating."

Mr. Lundbye answered many questions asked regarding the cleaning, chrome plating the light coatings, and the oil treatment. Mr. Lundbye also said that he would be glad to have any of our members call on him at their plant in Springfield and that he would act as a consultant to help get anyone started on this method of "Tool Conservation."

The sound motion picture "Building a Medium Tank" (for U. S. Army) was very interesting and instructive.

Members who are missing these meetings are not getting the full benefit of their membership, and are urged to keep these meeting dates in mind. There were 100 in attendance at this meeting, which adjourned at 10.15 P.M.

J. W. HANLON, *Secretary*

### BOSTON BRANCH

Boston Branch met Thursday Feb. 4th at the Statler Hotel, Boston, with President Swift in the chair.

Minutes of the previous meeting read and approved; bills ordered paid; communications read and placed on file.

The application read for the first time and turned over to the board of managers for approval. Philip V. Bray, 874 Pleasant Street, Weymouth, Mass., Associate, one transfer from Springfield Branch to Boston Branch was accepted, Harry Goldberg, 78 Ashton Street, Dorchester, Mass., Active.

The question of whether the branch should hold a banquet this year was discussed and a committee appointed, Robert L. Smith as chairman, to arrange if possible for one date to be announced later.

Lou Gagnon had as the speaker, Mr. L. G. Stubbs, of the Mutual Chemical Co., New York, his subject was "Anodizing Aluminum by the Chromic Acid Process." He explained the method of preparing the work for racking stating that they should be fairly heavy so that they will not overheat, cleaning the work should be done in mild solutions and that tanks of wood or steel should be used. Anodizing the tank is made the cathode and is steel and shielded with insulating such as wire-glass and the bottom of tank may be covered with acid proof bricks, he discusses the bath as being about 2.5% and the pH 0.8 or 0.9. More of this

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A vote of thanks was given Mr. Tubbs for his fine talk; the meeting adjourned at 10.30 P.M.

A. W. GARRETT, *Secretary*

## CLEVELAND BRANCH

Minutes of the meeting of the Cleveland Branch of the American Electroplaters Society held in the Cleveland Hotel on February 6, 1943.

The meeting was called to order at 8:30 P.M. with our president, Mr. Wm. W. O'Berg, presiding.

The minutes of the previous meeting and also the treasurer's report were approved as read.

Under applications for membership the following names were submitted and then referred to the Board of Managers:

Fred H. Niehoff of Rocky River, Ohio, as Associate.

John W. Sparano of Cleveland, Ohio, as Active.

The following candidates whose names were submitted at the December meeting and which were published in the January, 1943 issue of *The Monthly Review* were elected to membership:

William Edwards of Cleveland, Ohio, as Associate.

Tully S. Hammer of Cleveland, Ohio, as Active.

Arlond E. Larson of South Euclid, Ohio, as Associate.

Henry J. Schmidt of Cleveland, Ohio, as Active.

Arthur E. Schuenemann of Cleveland Ohio, as Associate.

Mr. Stephen F. Miller gave a very interesting report on the Dinner Dance to be held in the Cleveland Hotel on Saturday evening, February 20th. The committee was authorized to offer a door prize and also to obtain favors for the ladies. This has all the ear marks of being a very successful affair, and attendance should be good.

The speaker of the evening, Mr. Robert W. Renton, of the Lea Mfg. Co., also one of our own members was introduced—not that Bob needed an introduction. He showed part of a roll of film taken by the Lea Mfg. Co. at the annual convention held last summer. Unfortunately something went wrong with the projection machine and he was not able to finish. Neither was he able to deliver his talk on Burring as considerable time was lost trying to repair the projection unit. All of the members expressed a keen desire to see all of this film and to hear his talk and it is hoped that Bob will be able to do both at another meeting.

There being no further business, the meeting adjourned at 10:45 P.M.

GEORGE S. SVENSON, *Secretary*

## LOS ANGELES BRANCH

The Los Angeles Branch held its regular monthly meeting Feb. 1, 1943 at the Elks Club, 607 S. Parkview.

The meeting was called to order by President Holman.

Stanley Rynkoff, Sergeant-at-Arms introduced the following visitors: J. R. Makepeace, Menasco; Don Orr. Cad. Nickel; Frank Manley, Bower's Mfg.; E. F. Van Winkle, Vega Aircraft; Carl Hirdler, Turco Product Co.; D. E. Dawson, North American Aircraft; A. N. Arnold, Blaksley Mfg. Co.; Dean William, Northrup Aircraft; Mr. Simbrown, Turco Products Co.; Mr. J. S. Norris, Gilmore Oil Co.

Minutes and financial reports were read and approved. Bills ordered paid.

Mr. Marcus Rynkoff reported on the Annual Educational and Dinner Dance stating that it will be held in the Grand Ballroom of the Elks Club, March 20th. The speakers will speak on war work and will come from all parts of the U. S. A.

Three members were elected to membership. Archie J. Peverley (associate), 8901 S. Wilton Pl.; John L. Damon (associate), Room 917-1031 S. Broadway and Gilbert J. Yontz (active), 1217 E. 58th Dr.

Under new business someone asked for information pertaining to freezing of jobs. Mr. Holman read a very interesting article from Industrial News of Jan. 3, 1943, which answered all questions.

Meeting was then turned over to Librarian, Mr. ApRoberts, who introduced Mr. J. S. Norris of Gilmore Oil Co., who read us a paper on Rust Prevention, which was sent to the *Review*.

Mr. Bob Gripp, the first President of the Los Angeles Branch gave a talk on

changing from cadmium to zinc. Bob brought out some of his own experiences. He said that operations were very near the same in both baths. He found out the more you filter the more you have to filter it. High current produces roughness. Carbon treatment will help. He has been working on anode bags that will stand up in zinc solution.

Mr. Eldered was asked to say a few words on zinc. He also emphasized the importance of cleaning the tanks that have been used for other things, such as cad., copper and etc. A reverse current should be used to take any plated metal on sides of tank off. Wash out with watar several times before a very thorough rinse with muriatic acid solution. This should be handled with care, in open air if possible.

Mr. ApRoberts thanked the speakers for their talks and by the applause they were enjoyed by the entire group.

Meeting was turned back to President Holman.

Meeting adjourned 10:30 P.M.

C. C. MCLAREN, *Secretary*

### PITTSBURGH BRANCH

The Pittsburgh Branch of the A.E.S. held their regular meeting February 4th at the Fort Pitt Hotel. With the reduction in driving we decided to hold one meeting in the downtown section to make it easier for the men as far as transportation is concerned. It proved to be such a success that we are planning to have our next meeting March 4th at the Fort Pitt Hotel also. The meeting will be a dinner meeting again with the dinner starting at 7:00 P.M.

We had 48 present at the February meeting which is a large turnout for our group which has only 54 members. We were fortunate in having a roast beef dinner which everyone enjoyed very much. The business meeting was dispensed with and we had two moving pictures by General Electric on Railroads and Civilization. Mr. Dudley of the United Chromium Corporation gave a paper on Hard Chromium Plating. The paper was very interesting and was followed by a lengthy discussion and question period. The meeting was adjourned at 11:00 P.M.

FRANK R. KELLER, *Secretary*

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## CINCINNATI BRANCH REGIONAL MEETING

Saturday, March 26th, is the date set for the rousing Regional meeting to be held at Hotel Gibson by the Cincinnati Branch.

The Committee has rounded out a top-flight program, which starts at 7:30 P.M.

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# THE ABSTRACT SECTION

**GEORGE WAGNER**

*Chairman Program and Educational Committee*

**Anodic Treatment of Plain Carbon Steels.** By ROBERT L. IMBODEN and ROBERT S. SIBLEY. *Trans. Electrochem. Soc.* **82** (Preprint 18) (1942). Electropolishing has been less successful on plain carbon steels than on alloy steels. Five baths gave satisfactory results on specimens of plain low carbon steel, previously polished with 3/0 paper, for microscopic examination:

| No. Composition | C.d., amp./sq. in. etching | C.d., amp./sq. in. polishing | Time | Temperature |
|---|---|---|---|---|
| 1. 40% sulfuric acid, 48% phosphoric acid, 12% water | 1-4 | 5-8 | 10 in. | 95-122° F. |
| 2. 39% sulfuric acid, 45% phosphoric acid, 7% glycerine, 9% water | 0.75-2 | 3-7 | 12-20 in.<br>5-10 in. | 72-122° F.<br>104° F. |
| 3. 40% sulfuric acid, 46% phosphoric acid, 4% dextrose, 10% water | 0.8-1 | 1.5-4.5 | 5-10 in. | 82-104° F. |
| 4. 15% sulfuric acid, 65% phosphoric acid, 5% chromic acid, 15% water | 0.75-2 | 3-7 | 5-10 in. | 108-131° F. |
| 5. 765 cc. acetic anhydride, 185 cc. perchloric acid, 50 cc. (CAUTION): Explosive above 86° F.) | 0.35-0.8 | 0.25-0.35 | 3-5 min. | below 86° F. |

The last three were the best. Polishing appears to result from an insulating film of polarizing material (oxygen) or of metal salts, protecting low spots on the anode, while the protruding high spots are rapidly dissolved. Agitation avoids the adherence of bubbles, which cause undulations in the surface, but too vigorous agitation partially removes the film and slows down the polishing. Mild agitation also minimizes pitting at surface inclusions in the metal, which results from the discontinuity of the insulating film at the inclusion. Compared to mechanical polishing, electrolytic polishing emphasizes inclusions, gives relief to carbide particles, and tends to give wavy surfaces. It is advantageous in its ability to polish any shape of specimen on all of its faces, affording better etching, polishing much faster and demanding almost no skill, and giving a more brilliant surface free from the distorted surface of flowed metal unavoidable with mechanical polishing, thereby affording a truer picture of the metal. Apparatus and cells are described. Two dimensional studies (of two faces at right angles) are recommended to permit better interpretation of metal structures.

**Single Metal, Binary, and Ternary Alloy Deposition from Thiosulfate Solutions. II. Binary Alloy Deposition of Copper-Nickel, Copper-Cadmium and Copper-Zinc Alloys from Thiosulfate Solutions.** By D. C. GERNES and G. H. MONTILLON. *Trans. Electrochemical Society* **81** (Preprint 20) (1942). Alloy deposits were made from thiosulfate baths of the following typical compositions in g./l.:

| ALLOY | Copper-Nickel | | | Copper-Cadmium | | | Copper-Zinc (Brass) | | |
|---|---|---|---|---|---|---|---|---|---|
| Cu. in. deposit | 70% | 50% | 35% | 70% | 50% | 35% | 70% | 50% | 35% |
| $Na_2S_2O_3.5H_2O$ | 250 | 250 | 250 | 250 | 250 | 250 | 210 | 184 | 200 |
| $Cu_2Cl_2$ | 19 | 17 | 13 | 19 | 18 | 12 | 10 | 16 | 10 |
| $NiCl_2.6H_2O$ | 40 | 40 | 40 | .... | .... | .... | .... | .... | .... |
| $CdSO_4.8/3\ H_2O$ | .... | .... | .... | 40 | 40 | 40 | .... | .... | .... |
| $Zn\ SO_4.7H_2O$ | .... | .... | .... | .... | .... | .... | 40 | .... | .... |
| $Zn\ Cl_2$ | .... | .... | .... | .... | .... | .... | .... | 81 | 70 |
| $(NH_4)_2SO_4$ | .... | .... | .... | .... | .... | .... | 50 | .... | .... |
| $NH_4Cl$ | 40 | 40 | 40 | 40 | 40 | 40 | .... | 111 | 72 |
| Temp. °C. | 25° | 25° | 25° | 25° | 25° | 25° | 60° | 24° | 24° |
| Current Density amp./sq. ft. | 14 | 7.5 | 8.5 | 14 | 14 | 8.5 | 14 | 7.5 | 8.5 |
| Agitation | yes | yes | yes | yes | yes | yes | no | no | no |
| Adherence | good | avg. | avg. | avg. | fair | poor | avg. | poor | poor |
| Color | gray sl. copper | light gray | silver gray | gold bronze | light bronze | silver gray | yellow | gold | gray light yellow |

The effect on the copper content of the deposits of varying the concentrations of the bath constituents and plating conditions is summarized:

| Alloy | Copper-Nickel | Copper-Nickel | Copper-Cadmium | Copper-Zinc |
|---|---|---|---|---|
| $Cu_2Cl_2$ in bath | Below 13-19 g./l. | Above 13-19 g./l. | 2.5-35.5 g./l. | 8.0-17.9 g./l. |
| Agitation | decrease | increase | increase | undetd. |
| Increase in: | | | | |
| Current density | increase | decrease | decrease | decrease |
| Temperature | undetd. | undetd. | increase | increase |
| Copper in bath | increase | increase | increase | increase |
| Thiosulfate | decrease | decrease | decrease | decrease |
| Addition of: | | | | |
| $NH_4Cl$ | decrease | increase | increase | increase |
| $NaHSO_3$ | decrease | sl. increase | sl. increase | undetd. |

The deposits were very generally bright. The copper-nickel deposits had a coppery tinge above 50% copper, and a definite copper color above 85%; the sulfur content of the plate varied from 2% with 90% copper, to 35% with 10% copper. The copper-cadmium alloys contained from 2 to 8% sulfur, but generally around 5%. The copper-zinc alloys contained 3.5-8% sulfur.

The copper-zinc alloys showed the following colors after buffing:

| Copper content | Color |
|---|---|
| above 80% | Red-brass |
| 75-80% | Reddish-yellow |
| 65-75% | Yellow-brass |
| 55-65% | Light yellow-brass |
| 45-55% | Gold |
| 40-45% | Light yellow |
| 35-40% | Very light yellow |

The cathode efficiencies were generally high. The baths appear to decompose slowly. Much data is presented of interest to the student of alloy-plating.

By ERNEST H. LYONS, JR.

# BOOK DEPARTMENT

## *BOOK REVIEWS*

By

DR. GEORGE DUBPERNELL, *United Chormium, Inc.*

**Journal of the Electrodepositors' Technical Society.** Volume 17, 167 pages, 1941-1942. Published by the Society, c/o Northampton Polytechnic Institute, St. John Street, Clerkenwell, London, E. C. I., England. Price, One Guinea (about $4.25).

The volume under review was apparently published in December, 1942, and the faithful of our sister society are indeed deserving of our congratulations on its production undr wartime conditions, with no decrease in the high quality standard set by the preceding issues. The only marks of the war noted were a decrease in the quality of the paper used, and the fact that the volume covers a two-year period instead of one as formerly. The papers included are as follows:

"Silver Coatings On Non-Metallic Surfaces," J. R. I. Hepburn, pages 1-13. Details are given of the technique of silvering non-metals by immersion, using any one of three solutions investigated by the author – the Cane Sugar, the Formaldehyde, and the Rochelle Salt Formula. The thickness of deposit after varying times, and methods of thickness determination were investigated.

Discussion to a paper in Volume 16 on the "B.N.F. Jet Test For Determining The Thickness Of Silver Coatings," R. A. F. Hammond, pages 14-16.

Discussion to a paper in Volume 16 on "The Anodic Polishing of Eletcroplated Nickel," A. W. Hothersall, pages 17-18. This was an unusual paper on a new subject when it appeared, but conditions have forced less interest in the matter!

The discussions at three meetings devoted to "Problems Confronting Platers During War Time" are given on pages 19-33. These correspond closely to the Question Box period in many A. E. S. meetings, and contain many items of interest.

"Solvent Economy in Trichlorethylene Degreasing Plants," W. F. Jesson, pages 34-44.

"The Jointing of Metals By Fusion, With Particular Reference to Finishing and Plating," A. E. Richards, pages 45-74. Covers hard and soft soldering, brazing and welding. Excellent illustrations including a number of melting point diagrams.

"The Annual Meeting," pages 75-82. A report of the Society business for 1941.

"Current Distribution On The Inside Of Oval Cylinders With Various Shapes Of Internal Electrodes," J. Kronsbein, pages 83-104. A study related to those of Dr. Charles Kasper of the National Bureau of Standards.

"Practical Problems In Electrotinning," S. Baier, pages 105-127. An excellent review of many phases of the use of the alkaline stannate bath and also the acid bath.

"Recent Developments in Metal Rectifiers As Applied To Electrodeposition," D. Ashby, pages 129-146. Covers both the copper oxide and the selenium rectifier. 16 illustrations.

A discussion on "Ministry Of Aircraft Production Specifications And Tests" is reported on pages 147-154.

"Experiences With Alkaline Zinc Plating," J. S. Jones and P. M. Walker, pages 155-163. The authors, who are associated with the British Thomson Houston Co., Ltd., give the following synopsis: "Bright and dull zinc plating. Still vat process. Barrel plating process. Combined treatment of plating and bonderizing. Notes on solution maintenance."

The volume is well indexed on pages 165-167, and for its size constitutes a very worthwhile addition to any plating library.

★ ★ ★

(1) **Standard Handbook for Electrical Engineers.** Edited by A. E. KNOWLTON and R. M. SHOOK. 2303 pages, $8.00.

(2) **Cleaning and Finishing Metal Products.** Published by Iron Age. 235 pages, $3.00.

(3) **Modern Metallurgy for Engineers.** By FRANK T. SISCO, 432 pages, $4.50.

(4) **An Introduction to Electrochemistry.** By SAMUEL GLASSTONE. 553 pages, $5.00.

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**MAURICE R. CALDWELL**
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**To January, 1943**

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| BRANCH | May 1942 | Change in Membership | Percent Change |
|---|---|---|---|
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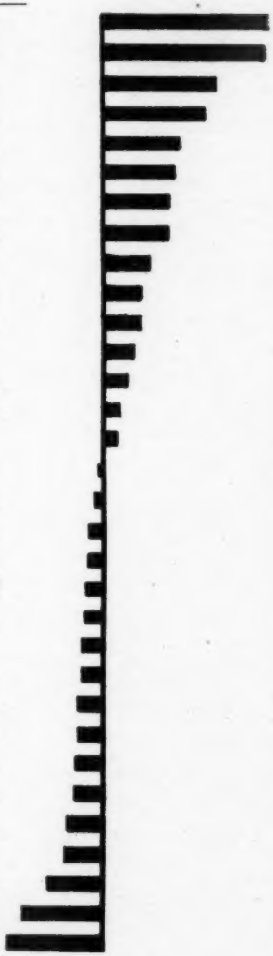
| INDIANAPOLIS | 48 | +10 | +20.8 |
| BALT.-WASHINGTON | 82 | +15 | +18.3 |
| MONTREAL | 44 | + 6 | +13.6 |
| SYRACUSE | 31 | + 4 | +12.9 |
| BUFFALO | 55 | + 6 | +10.9 |
| NEWARK | 156 | +16½ | +10.8 |
| TORONTO | 87 | + 7 | + 8 |
| CHICAGO | 258 | +17 | + 6.6 |
| WATERBURY | 97 | + 6 | + 6.2 |
| ROCHESTER | 80 | + 4 | + 5 |
| PITTSBURGH | 52 | + 2 | + 3.8 |
| SAN FRANCISCO | 46 | + 1 | + 2.2 |
| PROV.-ATTLEBORO | 49 | + 1 | + 2 |
| HARTFORD | 67 | — ½ | — .7 |
| DETROIT | 277 | — 3 | — 1.1 |
| BOSTON | 118 | — 2½ | — 2.1 |
| LANCASTER | 44 | — 1 | — 2.3 |
| NEW HAVEN | 105 | — 2½ | — 2.4 |
| MILWAUKEE | 97 | — 2½ | — 2.6 |
| DAYTON | 99 | — 3 | — 3 |
| BRIDGEPORT | 80 | — 2½ | — 3.1 |
| NEW YORK | 139 | — 5½ | — 3.9 |
| LOS ANGELES | 128 | — 5 | — 3.9 |
| SPRINGFIELD | 72 | — 3½ | — 4.8 |
| ST. LOUIS | 82 | — 4 | — 4.8 |
| BINGHAMTON | 16 | — 1 | — 6.3 |
| GRAND RAPIDS | 87 | — 5½ | — 6.3 |
| PHILADELPHIA | 142 | —14 | — 9.9 |
| ANDERSON | 38 | — 5½ | —14.5 |
| TOLEDO | 46 | — 8 | —17.4 |



MEMBERSHIP — May 1st, 1942 = 2845
MEMBERSHIP — March, 1943 = 2901
GAIN IN MEMBERSHIP = 56
Percent of Gain = 2%

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# BUYERS' GUIDE

## ANODES—NICKEL

Seymour Mfg. Co., Seymour, Conn.

## ANODES—ZINC

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Meaker Company, The, Chicago, Ill.
Seymour Mfg. Co., Seymour, Conn.
Stevens, Frederic B., Inc., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

## BALL ANODES

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

## BUFFS AND BUFFING COMPOSITIONS

Advance Polishing Wheels, Inc., Chicago, Ill.
Apothecaries Hall Co., Waterbury, Conn.
Burns, E. Reed, Corp., Brooklyn, N. Y.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harrison & Co., Haverhill, Mass.
L'Hommedieu, Chas. F., & Sons, Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Matchless Metal Polish Co., Glen Ridge, N. J., and Chicago, Ill.
Puritan Mfg. Co., Waterbury, Conn.
Roberts Rouge Co., Stratford, Conn.
Stevens, Frederic B., Detroit, Mich.

## BUFFS AND BUFFING COMPOSITIONS

Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
United Laboratories, Linden, N. J.

## BURNISHING BARRELS AND BALLS

Abbott Ball Co., Hartford, Conn.
Baker, M. E., Co., Cambridge, Mass.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Magnuson Products Corp., Brooklyn, N. Y.
Storts Welding Co., Inc., Meriden, Conn.

## BURNISHING COMPOUNDS

Ford, J. B., Co., The, Detroit, Mich.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Lasalco, Inc., St. Louis, Mo.
Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York City

## CADALYTE PLATING MATERIALS "CARBONATE REMOVER"

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Lasalco, Inc., St. Louis, Mo.

## CADMIUM SERVICE

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Udylte Corp., The, Detroit, Mich.

## CADUX MATERIALS

Hanson-Van Winkle-Munning Co., Matawan, N. J.

## CEMENT—GLUE SUBSTITUTE

Harrison & Co., Haverhill, Mass.

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## CEMENT POLISHING WHEEL

Harrison & Co., Haverhill, Mass.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.

## CHROMIUM SERVICE

Hanson-Van Winkle-Munning Co., Matawan, N. J.
United Chromium, New York City

## CLEANERS AND CHEMICALS

Apothecaries Hall Co., Waterbury, Conn.
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Enthone Co., New Haven, Conn.
Ford, J. B., Co., Wyandotte, Mich.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harshaw Chemical Co., The, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
McGean Chemical Co., The, Cleveland, Ohio
Meaker Company, The, Chicago, Ill.
Merck & Co., Inc., Rahway, N. J.
Norton Co., Worcester, Mass.
Oakite Products, Inc., New York City
Pennsylvania Salt Mfg. Co., Philadelphia, Pa.
Puritan Mfg. Co., Waterbury, Conn.
Stevens, Frederic B., Inc., Detroit, Mich.
Sulphur Products Co., Greensburg, Pa.
Udylite Corp., The, Detroit, Mich.
Zialite Corporation, Worcester, Mass.

## COILS—PLATING TANKS

Heil Engineering Company, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn
United States Stoneware Co., The, Akron, Ohio.

## DEGREASERS

Blakeslee, G. S., & Co., Chicago, Ill.
Detroit Rex Products Co., Detroit, Mich.
Mechanical Process, South Orange, N. J.
Phillips Mfg. Co., Chicago, Ill

## EQUIPMENT

Alsop Engineering Corp., Milldale, Conn.
Blakeslee, G. S., & Co., Chicago, Ill.
Ceilcote Company, Cleveland, Ohio
Detroit Rex Products Co., Detroit, Mich.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hammond Machinery Builders, Kalamazoo, Mich.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Heil Engineering Co., Cleveland, Ohio
Industrial Filter & Pump Mfg. Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
L'Hommedieu, Chas. F., & Sons Co., Chicago, Ill.
Meaker Co., The, Chicago, Ill.
Mechanical Process Company, South Orange, N. J.
Miller, J. C., Company, Grand Rapids, Mich.
Paasche Airbrush Company, Chicago, Ill.
Packer Machine Co., The, Meriden, Conn.
Phillips Mfg. Co., Chicago, Ill.
Stevens, Frederic B., Inc., Detroit, Mich.
Storts Welding Co., Meriden, Conn.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
United Laboratories, Linden, N. J.
United States Stoneware Co., The, Akron, Ohio.

## LEAD LINED TANKS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Heil Engineering Company, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn.
Udylite Corp., The, Detroit, Mich.
United States Stoneware Co., The, Akron, Ohio.

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## MEAKER PROCESS GALVANIZING

Meaker Company, The, Chicago, Ill.

## METAL LACQUERS AND FINISHES

Alrose Chemical Co., Providence, R. I.
Atlas Powder Co., Zapon Div., Stamford, Conn.
Egyptian Lacquer Mfg. Co., New York City
Heatbath Corporation, Springfield, Mass.
Maas & Waldstein Co., Newark, N. J.
New Wrinkle, Inc., Dayton, Ohio
Preciment Laboratories, New York City

## METAL WORKING LUBRICANTS

Magnus Chemical Co., Garwood, N. J.
Oakite Products, Inc., New York City

## OXIDIZING AGENTS

Lasalco, Inc., St. Louis, Mo.
Mitchell-Bradford Chemical Co., Bridgeport, Conn.
Puritan Mfg. Co., Waterbury, Conn.
Sulphur Products Co., Greensburg, Pa.

## PLATING BARRELS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
Stevens, Frederic B., Inc., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

## PLATING TANKS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Heil Engineering Company, Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Stevens, Frederic B., Inc., Detroit, Mich.
Storts Welding Co., Meriden, Conn.

## PLATING TANKS

Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.
U. S. Stoneware Co., New York City

## POLISHING LATHES

Baker, M. E., Co., Cambridge, Mass.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hammond Machinery Builders, Kalamazoo, Mich.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
L'Hommedieu, Chas. E., & Sons Co., Chicago, Ill.
Stevens, Frederic B., Detroit, Mich.
Stutz, George A., Mfg. Co., Chicago, Ill.
Udylite Corp., The, Detroit, Mich.

## PLATING—PRECIOUS METALS

Baker & Co., Inc., Newark, N. J.
Merck & Co., Rahway, N. J.
Spectranome, New York City

## POLISHING WHEELS AND MATERIALS

Advance Polishing Wheels, Inc., Chicago, Ill.
Baker, M. E., Co., Cambridge, Mass.
Burns, E. Reed, Brooklyn, N. Y.
Divine Brothers Co., Utica, N. Y.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.
L'Hommedieu, Chas. E., & Sons Co., Chicago, Ill.
Matchless Metal Polish Co., The, Glen Ridge, N. J., and Chicago, Ill.
Miller, J. C., Co., Grand Rapids, Mich.
Puritan Mfg. Co., Waterbury, Conn.
Roberts Rouge Co., Stratford, Conn.
Stevens, Frederic B., Detroit, Mich.
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Udylite Corp., The, Detroit, Mich.
United Labortories, Linden, N. J.

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## ROUGES

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Harrison & Co., Haverhill, Mass.
Lasalco, Inc., St. Louis, Mo.
Matcheless Metal Co., Glen Ridge, N. J.
Roberts Rouge Co., Stratford, Conn.
Stevens, Frederic B., Detroit, Mich.
Udylite Corp., The, Detroit, Mich.

## RUBBER-LINED TANKS

Heil Engineering Co., Cleveland, Ohio
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn.
United States Stoneware Co., The, Akron, Ohio.

## SOAPS

Hanson-Van Winkle-Munning Co., Matawan, N. J.
Lea Mfg. Co., The, Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Oakite Products, Inc., New York City
Udylite Corp., The, Detroit, Mich.

## SOLUTION CONTROL METHODS

du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Hanson-Van Winkle-Muning Co., Matawan, N. J.
Lasalco, Inc., St. Louis, Mo.

## SOLVENTS—DEGREASING

Blakeslee, G. S., & Co., Chicago, Ill.
Detroit Rex Products Co., Detroit, Mich.
Lasalco, Inc., St. Louis, Mo.
Lea Mfg. Co., The, Waterbury, Conn.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Mechanical Process Co., South Orange, N. J.
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Phillips Mfg. Co., Chicago, Ill.
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A. B. C. Chemical Co., Waterbury, Conn.

## STRIPPING COMPOUNDS

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du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Gumm, Frederick, Chemical Co., Inc., Kearny, N. J.
MacDermid, Inc., Waterbury, Conn.
Magnus Chemical Co., Garwood, N. J.
Magnuson Products Corp., Brooklyn, N. Y.
Oakite Products, Inc., New York City
Sulphur Products Company, Inc., Greensburg, Pa.

## TESTING INSTRUMENTS

American Instrument Co., Silver Spring, Md.
du Pont, E. I., de Nemours & Co., Inc., Wilmington, Del.
Harshaw Chemical Co., The, Cleveland, Ohio
Industrial Filter & Pump Mfg. Co., Chicago, Ill.
Kocour Co., Chicago, Ill.
Lasalco, Inc., St. Louis, Mo.

## TUMBLING BARRELS

Abbott Ball Co., Hartford, Conn.
Baker, M. E., Co., Cambridge, Mass.
Lasalco, Inc., St. Louis, Mo.
Storts Welding Co., Meriden, Conn.

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MacDermid, Inc., Waterbury, Conn.
Udylite Corp., The, Detroit, Mich.

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## WASHERS—METAL PARTS

Blakeslee, G. S., & Co., Chicago, Ill.
Detroit Rex Products Co., Detroit, Mich.

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# UDYLITE

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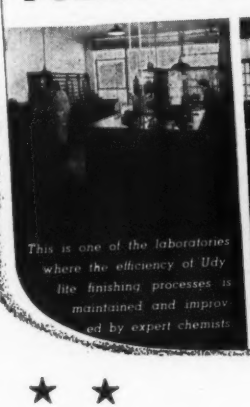

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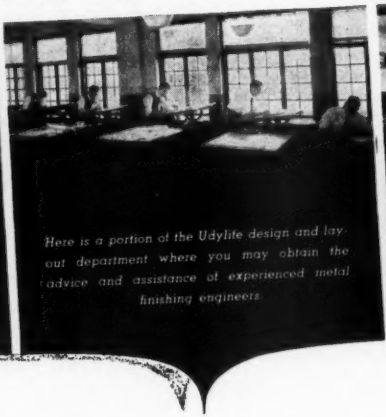

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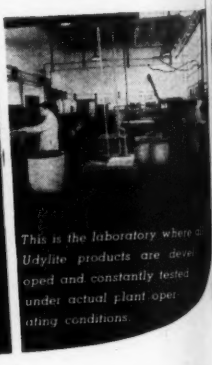

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★ ★ ★ ★

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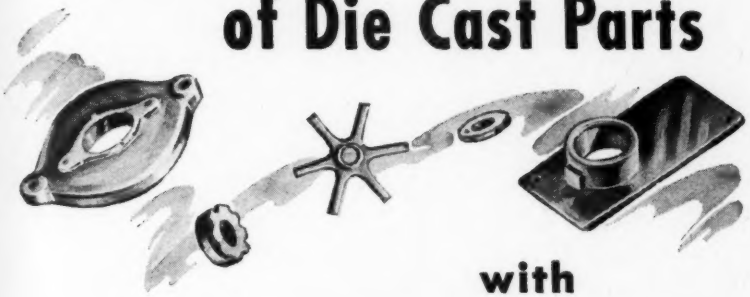
# SPEED-UP Finishing of Die Cast Parts



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• D-2530 Stop-Off Lacquer's qualification for production plating is its adoption, proven and constant use in HARD CHROME by a number of the largest producers of aircraft and marine motors, machine guns, landing gear and other highly technical items. In this production where hair-line tolerances are absolutely maintained, where stop-off insulations are required to give perfect service in long immersion, and where the speed and ease of applying stop-off lacquers are a MUST in production, D-2530 is doing a perfect job. Withstands other types of plating solutions.

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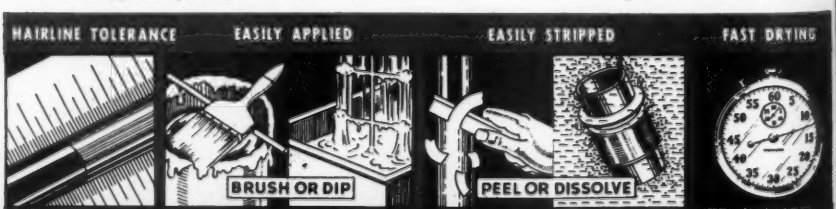


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WYANDOTTE PAINT PRODUCTS CO., WYANDOTTE, MICH.

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